

3 1761 11638577 4

CA1 5561

-58 Q72

Canada. Royal Canadian mounted police  
Crime detection laboratories  
Seminar

No. 5. Questioned documents in  
crime detection edited by Sgt.  
R.A. Huber. 1958.

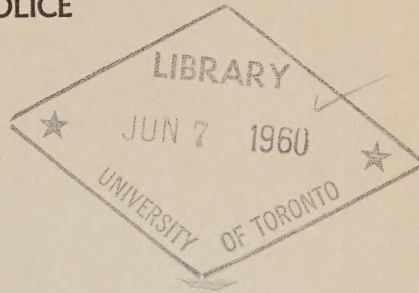




CA189 61  
-58 Q72

Government  
Publications

ROYAL CANADIAN MOUNTED  
POLICE



# CRIME DETECTION LABORATORIES

SEMINAR No. 5





ON RECORD

Proceedings of  
SEMINAR No. 5  
of the  
ROYAL CANADIAN MOUNTED  
POLICE

CRIME DETECTION  
LABORATORIES

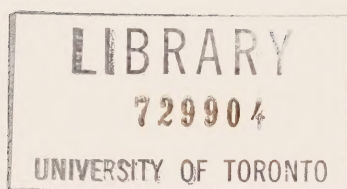
"Questioned Documents  
in Crime Detection"

Edited by Sgt. R. A. Huber

Ottawa, Canada

Oct. 27-Nov. 1, 1958 Inclusive

*Price, \$3*



Price \$3.00      Cat. No. J63-205  
Available from the Queen's Printer  
Ottawa, Canada



## FOREWORD

It is with pleasure that I offer to forensic scientists the record of another seminar conducted by the Royal Canadian Mounted Police Laboratories, for a second time on the subject of "Questioned Documents".

It is hoped that these contributions will promote and improve the work in the various fields of forensic science in order that the Courts may be provided with the best assistance procurable.

It is our purpose in producing this record of the proceedings to give to all concerned the benefit of the knowledge and practices of those who attended, whether such were presented formally, as scientific papers, or informally, in the course of open discussion. The program was designed to provide flexibility to encourage the free exchange of ideas and material, both new and old.

These endeavours are never without a great deal of planning and preparation and I would like to express to all who contributed to or participated in the meeting, my sincere appreciation for their efforts.

C. E. RIVETT-CARNAC,

*Commissioner.*

Royal Canadian Mounted Police,  
Ottawa, Ontario, Canada,  
2nd April, 1959.



Digitized by the Internet Archive  
in 2023 with funding from  
University of Toronto



## ERRATA

Page 11—1st paragraph 3rd line “whit” should read “wit”.

Page 121—3rd, 4th and 5th paragraphs should read as follows:—

A few terms need definition. When a particular event occurs, it is referred to as a *success* (s); if it does not occur, as a *failure* (f). If the event can occur in  $s$  ways and fail in  $f$  ways and all of these ways are equally likely to

happen, then the probability of success ( $p$ ) is defined as  $p = \frac{s}{f+s}$  and the

probability of failure ( $q$ ) as  $q = \frac{f}{f+s}$

From manipulation of these fractions it is apparent that the sum of the probability of success and failure is 1, that is,  $p+q=1$ . If an event is certain to happen it has a probability of 1, and if it cannot happen, it has a probability of 0. It can be seen from the definitions that the values of probability of success and failure,  $p$  and  $q$ , always lies between 0 and 1. Thus, probability is expressed either as a fraction or as something which may happen once in so many times. ( $s$  times out of  $f+s$ .)

Now, if we have several events, each with their probability of occurrence as  $p^1, p^2, p^3, \dots$  up to  $p^n$  and each event is independent of every other, then the probability of all events happening simultaneously is the product of their individual probabilities.

$$\left( P = \prod_{i=1}^n p^i \right)$$

Page 125—1st paragraph should read as follows:—

To handle the mathematics requires consideration of the calculus. Rather than defining the joint probability ratio as a product of the individual probability ratios we now define it as a multiple integral the series of probability functions which appears in its most general form as (7):

$$P = \int \int \dots \int f(p_1, p_2, \dots p_n) dp_1 dp_2 \dots dp_n$$

where  $f(p_1, p_2 \dots p_n) \geq 0$

This formula requires that the function,  $f(p_1, p_2, \dots p_n)$  be defined according to the conditions of the cases which in the handwriting identification problem under consideration is our toughest hurdle. Having gotten ourselves to this dilemma, we must now quietly retreat and figure out how by making certain approximations we might handle this phase of the problem in terms of multiplication of factors as we did originally with factors of form.





## PROGRAM

### Tuesday, Oct. 28, 1958.

- 8:45 A.M. — Opening Ceremonies "H.Q." Building Auditorium.
- 9:00 A.M. — Visit: R.C.M.P. Fraudulent Cheque File.
- 10:00 A.M. — Visit: British American Bank Note Company.
- 1:30 P.M. — Visit: R. L. Crain Ltd., Printers.
- 7:30 P.M. — Panel Discussion "A" — Status and Qualifications.
- 8:30 P.M. — Open House — Ottawa Crime Detection Laboratory.

### Wednesday, Oct. 29, 1958.

- 9:00 A.M. — Causes and Effects in Penmanship — F. Richardson.
- 10:00 A.M. — Psychological Studies of Handwriting — D. M. Duke.
- 11:00 A.M. — Left Handed and Ambidextrous Writings — A. Zitzelsberger.
- 1:30 P.M. — Sound Film — "Keys to Quality".
- 2:00 P.M. — Potentialities of the Blink Microscope — R. A. Huber.
- 2:40 P.M. — Proportional Spacing Typewriters — L. Godown.
- 3:20 P.M. — Escapement Actions — D. J. Purtell.
- 4:00 P.M. — Panel Discussion "B" — Standards and Research.

### Thursday, Oct. 30, 1958.

- 9:00 A.M. — Unique Questioned Document Problems — A. W. Somerford.
- 9:45 A.M. — Cash Register and Cash Adding Machine Identification — J. Warren.
- 10:30 A.M. — A Review of The Printing and Duplicating Processes — A. M. Headrick.
- 11:30 A.M. — Sound Film — "Xerography".
- 1:30 P.M. — Visit: Capital Carbon & Ribbon Company.
- 3:00 P.M. — Security Printing.
- 4:00 P.M. — Sound Film — "How to Make a Good Impression".
- 4:30 P.M. — Relationship of Mathematical Probability to Handwriting Identification — O. Hilton.
- 7:10 P.M. — Sound Film — "Great White Trackway".
- 7:30 P.M. — Panel Discussion "C" — Scope.
- 8:30 P.M. — Panel Discussion "D" — Forgery.

### Friday, Oct. 31, 1958.

- 8:45 A.M. — Visit: Canadian Bank Note Company.
- 10:45 A.M. — Visit: E. B. Eddy Fine Paper Mill.
- 1:30 P.M. — Work Shop — Typewriter Maintenance and Repairing.

### Saturday, Nov. 1, 1958.

- 9:00 A.M. — Questioned Document Studies in Officer Training — A. Cole.
- 10:00 A.M. — Counterfeit Stamps and Stamp Impressions — J. Gayet.
- 11:30 A.M. — Panel Discussion "E" — Ethics and Evidence.
- 6:00 P.M. — Fellowship and Display of Exhibits.
  - Banquet — Guest Speaker: W. R. Jackett, Q.C.
  - Subject: Expert Witnesses in Court.





## ATTENDANTS

Lt. R. I. BOONE, Department of Public Safety, Charleston, W. Virginia, USA.  
Cst. R. G. BROOK, Fraudulent Cheque Section, R.C.M.P., Ottawa, Ontario.  
Cpl. D. N. BROWN, Crime Detection Laboratory, R.C.M.P., Ottawa, Ontario.  
Mr. A. COLE, U.S. Treasury Department, Washington, D.C., USA.  
Cpl. J. A. G. de la DURANTAYE, Crime Detection Laboratory, R.C.M.P., Ottawa, Ontario.  
Cpl. D. M. DUKE, Crime Detection Laboratory, R.C.M.P., Ottawa, Ontario.  
S/Sgt. N. W. DUXBURY, Crime Detection Laboratory, R.C.M.P., Sackville, N.B.  
Mr. J. GAYET, Esq., Scientific Police Laboratory, Lyons, France  
Mr. L. GODOWN, Esq., Memphis, Tennessee, USA.  
Cst. B. GROENEWEG, Fraudulent Cheque Section, R.C.M.P., Ottawa, Ontario.  
Sgt. C. C. HEAD, Crime Detection Laboratory, R.C.M.P., Regina, Sask.  
Cpl. A. M. HEADRICK, Crime Detection Laboratory, R.C.M.P., Sackville, N.B.  
Mr. O. HILTON, Esq., New York City, N.Y., USA.  
Cst. J. HODAY, Crime Detection Laboratory, R.C.M.P., Regina, Sask.  
Cpl. J. H. HODGINS, Crime Detection Laboratory, R.C.M.P., Sackville, N.B.  
Sgt. R. A. HUBER, Crime Detection Laboratory, R.C.M.P., Ottawa, Ontario.  
Insp. A. MASON-ROOKE, Crime Detection Laboratory, R.C.M.P., Ottawa, Ontario.  
T/Sgt. J. F. P. MCCARTHY, New York State Police, Albany, N.Y., USA.  
Lt. J. P. McNALLY, New York City Police, New York, N.Y., USA.  
Mr. R. J. PACKARD, Esq., Attorney-General's Laboratory, Toronto, Ontario.  
Lt. D. J. PURTELL, Chicago City Police, Chicago, Illinois, USA.  
Cpl. W. J. T. RANKIN, Fraudulent Cheque Section, R.C.M.P., Ottawa, Ontario.  
Mr. M. A. J. RENAUD, Crime Detection Laboratory, R.C.M.P., Ottawa, Ontario.  
Mr. F. D. RICHARDSON, Esq., High School of Commerce, Ottawa, Ontario.  
Cst. M. H. SCHMIDT, Crime Detection Laboratory, R.C.M.P., Ottawa, Ontario.  
Mr. A. W. SOMERFORD, U.S. Post Office Department, Washington, D.C., USA.  
Mr. L. H. THOMAS, U.S. Government, Washington, D.C., USA.  
Miss H. THOMPSON, Fraudulent Cheque Section, R.C.M.P., Ottawa, Ontario.  
Cpl. J. W. WARREN, Crime Detection Laboratory, R.C.M.P., Regina, Sask.  
Sgt. A. F. WILCOX, Fraudulent Cheque Section, R.C.M.P., Ottawa, Ontario.  
Cpl. A. F. WRENSHALL, Fraudulent Cheque Section, R.C.M.P., Ottawa, Ontario.



Back Row: Sgt. R. A. Hutter, R.C.M.P., Ottawa; Cpl. W. J. T. Rankin, R.C.M.P., Ottawa; Lt. J. Boddy, R.C.M.P., Regina; Cpl. H. G. Brook, R.C.M.P., Ottawa; Cpl. B. Greeneweg, R.C.M.P., Ottawa; Cpl. J. H. Hodgins, R.C.M.P., Sudbury; Cpl. A. M. Hendrick, R.C.M.P., Sudbury; M. A. J. Renaud, R.C.M.P., Ottawa; Cpl. J. W. Warren, R.C.M.P., Regina; Cpl. D. N. Brown, R.C.M.P., Ottawa; Cpl. P. S. Giesey, R.C.M.P., Ottawa; Second Row: Sgt. A. F. Wilson, R.C.M.P., Ottawa; R. J. Packard, Albany-Guelph Laboratory, Toronto; Lt. R. E. Bessie, W. Virginia State Police, Charleston; Lt. J. T. McNally, Police Department, New York City; T. Sgt. J. F. P. McCarty, New York State Troopers, Albany, N.Y.; S/Sgt. N. W. Duxbury, R.C.M.P., Regina; Cpl. D. M. Duke, R.C.M.P., Ottawa; Union Godown, Memphis, Tenn.; Cpl. M. H. Schmidt, R.C.M.P., Ottawa; Cpl. J. A. G. de la Durantaye, R.C.M.P., Ottawa; Cpl. D. E. Champagne, R.C.M.P., Ottawa.  
 Front Row: A. W. Sauerburt, U.S. Post Office, Washington; O. Hilton, New York City; A. Cole, U.S. Treasury, Washington; L. H. Thomas, U.S. Government, Washington; Capt. S. S. Smith, Pennsylvania State Police, Harrisburg; Miss H. N. Thompson, R.C.M.P., Ottawa; Jean Gayet, Police Laboratory, Surete Nationale, Lyons, France; Lt. D. J. Purcell, Police Department, Chicago; Illinois; Sgt. C. C. Head, R.C.M.P., Regina; Cpl. A. F. Wrenshall, R.C.M.P., Ottawa.

## CONTENTS

|  | PAGE |
|--|------|
| Opening Ceremonies .....   | 11   |
| Panel Discussion "A"— <i>Status and Qualifications</i> .....           | 14   |
| Moderator—Mr. Huber  |      |
| Members—Messrs. Hilton, Cole, Boone & Packard.                         |      |
| Causes and Effects in Penmanship—F. Richardson .....                   | 22   |
| Psychological Studies in Handwriting—D. M. Duke .....                  | 24   |
| The Left-Handed Writer—A. Zitzelsberger .....                          | 31   |
| Potentialities of the Blink Microscope—R. A. Huber .....               | 41   |
| Proportional Spacing Typewriters—L. Godown .....                       | 46   |
| Escapement Actions of Typewriters—D. J. Purtell .....                  | 57   |
| Panel Discussion "B"— <i>Standard and Research</i> .....               | 64   |
| Moderator—Mr. Hodgins.   |      |
| Members—Messrs. Cole, Godown, McCarthy & Thomas.                       |      |
| Unique Document Problems—A. W. Somerford .....                         | 71   |
| Cash Register and Cash Adding Machine Identification—J. Warren .....   | 89   |
| A Review of the Printing and Duplicating Processes—A. M. Headrick .... | 101  |
| Security Printing—H. W. Jackson .....                                  | 120  |
| Relationship of Mathematical Probability to Handwriting                |      |
| Identification—O. Hilton .....   | 121  |
| Panel Discussion "C"— <i>Scope</i> .....                               | 131  |
| Moderator—Mr. Headrick.  |      |
| Members—Messrs. Hilton, Hodgins, Purtell & Smith.                      |      |
| Questioned Document Studies in Officer Training—A. Cole .....          | 136  |
| Counterfeit Stamps and Stamp Impressions—J. Gayet .....                | 162  |
| Panel Discussion "D"— <i>Ethics and Evidence</i> .....                 | 175  |
| Moderator—Mr. Hodgins.   |      |
| Members—Messrs. Duke, Somerford, Godown & Duxbury.                     |      |
| Expert Witnesses in Court—W. R. Jackett, Q.C. ....                     | 180  |





## Opening Ceremonies—"H.Q." Auditorium

October 28 A.M.

Insp. A. MASON-ROOKE:

May I say it is a pleasure to witness this gathering of the participants of the 5th seminar of the Royal Canadian Mounted Police which is gathered to deal with all the ramifications and aspects of a rather broad subject to wit, Questioned Document Examination. It is significant that we start off the proceedings of this seminar in the Headquarters building of our Force, whose activities are certainly diversified and wide-spread in the geographic sense. We have had four previous seminars, three of them have been on other scientific aids to criminal investigation and I would like to say that I do not think this seminar or any of the others would have come about without the progressive outlook and the whole-hearted encouragement of the Commissioner of the Force. Therefore, it gives me a great deal of pleasure to have the privilege of introducing to you Commissioner L. H. Nicholson of the Royal Canadian Mounted Police.

Commissioner L. H. NICHOLSON:

Gentlemen, I see quite a few familiar faces here and I welcome the ones that are familiar and the ones joining us for the first time. Just as a matter of interest, since Insp. Mason-Rooke mentioned the diverse nature of the work of the Force, perhaps I can take a minute to tell you of about four or five events that I am involved in this week. Yesterday morning it was my task to speak to our band, which had a long and arduous tour this summer and this was my first opportunity to say thank you to them. Last night I had to attend the Horse Show, because we have taken part there in a mounted display of jumping, and I enjoyed it, of course. Today it is my pleasure, and I hope yours to take part in your opening session here where you are dealing with a scientific subject, one in which we are vitally interested.

I have to have an eye, when I go back to my office later this morning on the arrangements which are made for the security during the coming visit of his Royal Highness the Duke of Edinburgh. On Friday I have to be present during the commissioning at Kingston of one of our new patrol boats. There are two or three other points which I have omitted but that is the week's program, which perhaps does illustrate certainly the diverse nature of the work of the Force. To come back to your seminar, I do want you to know that we do welcome you. I do want you to know that we think it is a privilege for the Force to be able to take a leading part in arranging these study groups, these seminars which have been under way now for several years. I think we are particularly sensitive to the need for recognizing the distinct and scientific nature of the work our Laboratories do. I think we are sensitive to this because we are a police force and because from the beginning our Laboratories had to have in the back of their mind a certain reserve that faced them, caused by the fact that they were police Laboratories and a feeling, in some quarters, that a policeman, however tenuous the connection was with the investigator in the field, however objective he tried to be in his work in the laboratory, was bound to be influenced slightly by the fact that he was a member of the same Force that was making the field investigation and that this would in some way

perhaps shade his testimony. Now, we were conscious of this from the beginning. We did not think that it was the correct concept, and we were not ready to accept it. We felt that we could clearly draw the line between the work of the scientists in the laboratory and the more wideranging, perhaps speculative work of the police investigator and we have continued to adhere to that belief. It has grown stronger with the years and we are satisfied that the line can be drawn, but we accept that care must be taken to maintain and improve that status and standards of laboratory work. I am speaking of all laboratory subjects now, not just the one in which you are directly interested.

It is because of that feeling, that situation which we faced in 1938 when our laboratory started, that we have been particularly careful to do anything we can to improve, to raise the standards of this type of work and to put it where it properly belongs as a scientific subject removed from and handled in a different way to that of the field investigation. In this I am not being at all critical or downgrading the position of the investigator; he has a job to do and it is perhaps still, and always will be the principal task, but we put him in a different position and we draw a line between the way he works and the way the scientists must work. These are things which I am sure you have all thought of. I only mention them just as an indication of the way we think and the principles that we have tried to use from the beginning as our laboratory work got underway. I think also that there is a very special need for these seminars on subjects which are almost entirely forensic. Other sciences that are used forensically are developed and perfected in other scientific fields, (chemistry for instance), and are applied by us, with certain modifications perhaps. Nevertheless, these are not basically forensic sciences. I think it is right to think, though, that two at least, of the branches in which we work, one is yours, "document examination", the other is "ballistics", are almost entirely forensic. In that position they surely need group study and all the attention that we can give them to put them in their proper position as sciences.

I say therefore that I think there is a particular need for the sort of study that you are giving to this subject of document examination, which is almost entirely forensic, as it does not support or rest upon a study by scientists in other areas. I know that perhaps in certain spots, the matter of document examination flows out of the forensic field and is given other uses, other applications. It is not for me to say whether this is good or bad. But it is right to say and think of this subject for the present as having its principal use in matters which are forensic and that require demonstration in Court.

I want to mention my special interest in the subject which you are discussing in the panel on Thursday afternoon, "The Scope of Document Examination". How far should you go? Should it extend as widely perhaps as it is extending now or should certain limits be put upon it? This is a general problem that we meet in all fields; we are meeting it now in our identification work. Where does identification work, handled by our Identification Branch, start and stop? How much should be handled by specialists? How much should be handled by field men? Where is the line drawn between the work of the Identification Branch and the work of the Crime Detection Laboratory? Because these are topical subjects, I am very much interested in your panel discussion and will look forward to reading the record and hearing what conclusions you reached.

I think there must be some limits which require attention. I think if the thing ranges too widely it will lose some of its value and perhaps suffer. Just where the line should be drawn is a vital matter and I am glad you are looking at it.



Now, having made those three points, let me say that I do welcome you here particularly those who have come from outside Canada. A special word of welcome to the gentleman from France. I am very glad indeed that he has been able to join us. We are glad that our friends in the same field have come across from various places in the United States to sit with us again, to work with us during this week. We have a representative also from the Attorney-General's Laboratory in Toronto, and we are pleased to have him take part in these discussions. We feel that this is a joint effort. And with these words let me say that I wish you luck as you get along with your studies this week and I look forward to meeting you again on Saturday.

## Panel Discussion "A"

October 28

Members: Messrs. Hilton, Cole, Boone, Packard.  
Moderator: Mr. Huber.

### Topic: "Status and Qualifications"

*Question (1): What should be the minimum qualifications of a practicing document examiner?*

HUBER: Suppose we tackle this from the point of view of academic qualifications first.

HILTON: One difficulty I find in answering this question is simply because academic qualifications do not relate directly to our particular field of work. Nevertheless I feel today somewhat strongly that men starting out in the field should endeavour to have as the ideal minimum, if not a college degree, certainly some college training. I say that with a great deal of reservation because I have worked with older men in the field who have had virtually no formal education as we think of it today and yet they have been some of the most outstanding document examiners. The fact is that good academic training however is a training that would assist in studying and learning this particular type of work.

COLE: I have had many occasions when not the Court but attorneys have enquired about academic background. These questions were not asked with the idea nor was the criterion established that you might be regarded qualified if you can show substantial academic training. Some years ago, when the C.S. Commission gave its only examination for examiners of questioned documents academic training was mentioned only as a substitute for a period of experience. In other words, they began by saying we will accept applications from anyone who can show a rather substantial period of experience, then in lieu of two or three years of experience in the field he may substitute his academic training of a certain period of time, and I think that is the only proper way to look at it.

BOONE: I find in some jurisdictions that the judges themselves are inclined to feel that one should have substantial academic background and usually the prosecuting attorneys also. For an understudy, I would prefer a bachelor of science with some scientific background for I feel that many of these things which we touch on are basically modifications of the sciences and I would like to see a young man starting into it have at least a B.Sc. or a Masters degree if possible.

COLE: We ought not to be considering qualifications from the standpoint either of what you would like or what the prosecuting attorney would like or the judge would like but what does the man need to do the work.

BOONE: But you have got to sell yourself to the jury, and if you have a substantial background, I believe the jury gives you more consideration than if you did not.

HUBER: Mr. Cole, would you feel that the work requires the potential of a university graduate?

COLE: Certainly it does, but let me make one more objection to this particular line of discussion. The person who has let us say a Masters degree will usually be the person who has made a choice of a career which is far from the examination of questioned documents, so if you get such a man you are likely to get a man who has been undecided or whose previous plans have fallen through in some way or who has formed a sort of accidental connection with the field of the examination of questioned documents.

HILTON: It is probably true that due to the limited amount of work that is done in the field, the limited opportunities for anyone to find out about questioned document work at a time when they might be deciding on a career in pre-college or early college days, that a lot of people come on to the work all of a sudden after they have made up their mind that they want to do something else, and suddenly realize the potentials of this field. I do not think that because a man has followed a certain pattern of study in university even to the point of advanced degrees it would necessarily rule him out, since he might be initially entirely ignorant of existence of this work and realize later that he might have a very great interest in it.

HUBER: What course of studies do you feel would best prepare a man for work in this field?

COLE: I think that the kind of preparation which will best prepare a man is an apprenticeship under a qualified and established examiner.

HILTON: I would say that academically he should be well grounded in the fields of science and particularly the physical sciences, physics and chemistry, because those subjects have application to this field. He might well be grounded in foreign languages. Not only for the purpose of reading what is being done in other parts of the world but the ability to handle two or three other languages would assist so much in the examination of documents in foreign languages, and in my own locality I find that a constant problem. A third would be any academic training that would prepare him to express himself either verbally or in written material, in other words English Composition or public speaking that would better equip him for presenting his findings to courts, verbally or in writing.

HUBER: Since Mr. Cole has brought up the subject of apprenticeship, could we discuss this matter in terms of experience that should constitute a qualification for a practicing document examiner? At what point should an individual be considered capable of taking matters to court?

COLE: I think it is rather idle to specify a period of time without saying something about the quality of the man's experience. In other words, I feel that experience should be gained in a place where substantially all of a person's time would be spent on studies of documents or closely related studies and then I think that one should not specify, unless he were obliged to as a matter of convenience, a definite period of time. I think he should simply say "a substantial period of time" and leave it to a matter of judgment by others who would be directly concerned with the accuracy of a man's work, the speed of a man's work, how is work impressed or affected other people to say when he had served that substantial period of time.

HILTON: As an apprentice under a qualified examiner, I think that whether or not he is ready, whether he has the minimum of qualifications depends upon whether in the eyes of his teacher he is able to consistently solve problems



accurately, and with handwriting I think this is the thing he is going to get a hold of, last. I think handwriting is a more difficult problem although we deal with it more. There are other types of identification problems in the document field that are much easier for the beginner to grasp, they are more mechanical. Also, whether he has confidence in his own findings can only be told by someone who reviews his work, who sits down with him and interrogates him much as he would be under cross-examination to see how he stands up. I always feel that in the courtroom situation you can have things sprung on you and it is the place where the partially qualified man is going to get into deepest water and greatest difficulties because he is working under pressure. Therefore, you have got to try and evaluate how this man could stand up under that kind of pressure.

### Discussion open to the floor

SOMERFORD: The Civil Service Commission has set up the specifications in such a manner that approximately four years are required before the individual is allowed to go into the courtroom stage. An individual commences at what is known as Grade GS5. Approximately two years later he would be, assuming that he met the qualifications of training and development, allowed to go into the Grade 7 area and then assuming that he succeeds for the next two years he would then go into the Grade 9. At the grade GS9 he would then be, according to the Civil Service standards perused, more or less automatically eligible for undertaking courtroom work. With respect to our own experience in training of approximately six of our own people as well as two from other departments and approximately 4 or 5 from foreign countries, we have found that it is necessary that the individual be continually tested as to how he is developing. In one instance we had a man that trained for approx. four years at the end of which time we found that he would not be able to successfully meet the standards of the profession. We have found that a minimum of three years of intensive training, which includes a study of the various systems of handwriting taught in our own country and foreign countries, familiarization with them as standards for their own evaluation of the characteristics, a study of typewriting and a study of other types of conditions that are relevant, and a maximum of four is necessary. Insofar as the F.B.I. is concerned I do know that they require a minimum of three and a half years according to the information I received last year.

HUBER: What would be the salary range then for a man starting out as a qualified court examiner, document examiner?

SOMERFORD: The salary rate for a GS9 is \$5,985. with 18 month increases over a period of several years until he reaches \$7,035. which he would never be required to wait for because within two years after the grade 9 he would be eligible for an 11, and the grade 11 is \$7,030. starting, through \$8,230. However, that is not the general salary of document examiners in the Federal Service.

GROENEWEG: Have any of the panel considered laying out a curriculum for understudies?

HILTON: The only program that I know of of that nature would be the course of studies with which the American Society of Questioned Document Examiners has been working and attempting to put into operation with some of their newer members. I do not think we have used it long enough for me to say whether or not it is successful or to otherwise evaluate it. I would say it was still in the growing stages but there has been that much of an attempt to cover a rather broad field of questioned document examination.

SOMERFORD: Regarding preparations for court presentations, we have experienced some success in having mock trials during the course of the individual's training, approximately four or five a year. Qualified examiners undertake to present a case to the trainee and interrogate him on the various aspects of the case as well as the field of documents and in that way we can judge his rate of progress as well as map out any new improvements that might be recommended or suggested for him. During the first four or five times that the trainee goes into court, a qualified examiner will appear with him and be the first witness, and take the brunt of testimony in order that the trainee may have the confidence initially that is so essential to the furtherance of his progress in this field. I have observed an individual after testifying in court over a period of time to become quite frightened by the necessity of going into court and that confidence I think is a most important element in the success of the examiner and should be handled very carefully throughout his training program.

MCNALLY: In the New York City Police Department Laboratory, we have trained a number of men over the past few years and as a sort of a text we have used one of Osbornes' books, that is before Mr. Hilton's was published but in addition to that we have also trained by actually working on various problems. We have used trainees on our unlawful letter file to get into the habit of going through the file and making comparisons to pick out the likely associations in our files. We have used them on our Fraudulent Cheque File to pick out associations there. Of necessity, our document examiners have to do their own photographic work, so we begin from the beginning and train them also in photography. In New York City the minimum qualifications to get into the police laboratory for the past few years have been a B.Sc. in chemistry. For the document section we generally pick somebody who has been there for a while and consequently we get men who have already been in court on a number of occasions who have testified as a chemist, who have gone through rigorous course of examinations in their own particular field of chemistry. In opposition to what Mr. Hilton said, these men have told me, that as far as chemistry is concerned in document work it is of very little value to them. That is in police document work, how it would be on the outside, I don't know. With men who have not had previous experience in court, we find that the best thing to do with them is to work with them on a case and have them give the grand jury presentation. There they are not subject to a cross examination of any type except to a few questions handed them by the jurors. This gets them used to the idea of getting up and qualifying themselves and presenting their testimony. Subsequently, I usually handle the trial work. Then again we have a number of men who have not testified in the higher courts before a jury but have testified in the lower courts. We have them testify in lower courts first so that they are more accustomed to working in a courtroom and they make a better appearance when we have a full jury sitting. We feel that with the volume of business that we do, we actually have an accelerated course and that two years is enough in our own particular field to determine whether or not we have a fellow who is qualified to testify. University or college is set up so that it teaches a man how to think and we feel that if he has four years university behind him he knows how to think. I would say the degree in itself is not necessary for document examination. It is of value but in itself it is not of the prime importance. The man himself is the thing that determines his suitability.

HUBER: How do you feel about the application of such a course of studies as psychology, particularly with respect again to handwriting which seems to be the larger portion of our work?

McNALLY: I feel the identification of handwriting in itself is particularly difficult. The application of psychology to it would confuse the issue. In the liberal arts field, a course in effective English composition, to enable one to present an answer to a problem in a way that could be understood, and a good course in public speaking are desirable. Handwriting in document identification is a difficult enough thing to do without getting into the field of psychology, without dealing with somebody's mind which is extremely complex.

DUKE: This subject of psychology in handwriting is one on which I have some very definite views which you will hear tomorrow. But I do not feel that the study of psychology alone is a necessary requisite. I think a person should also have a grounding in physics and chemistry with possibly several courses in psychology not so much for the application of psychology to handwriting in itself which is a questionable field at the present time but I do think that psychologists have run up against problems which are common to the document examiner. They have been trying for many years to establish psychology as a definite scientific field and have run into a lot of public prejudice. To document Examiners how often is the question put in court. "Now is handwriting identification really a science?" I think the value in psychology lies the fact that it gives a person a basic knowledge of scientific principles and methodology which are more or less taken for granted in the study of the physical sciences, chemistry and physics. The methods there are generally accepted without question whereas in psychology you have to be extremely careful every step of the way to make sure that you are acting in accordance with scientific principles. I think therein lies the value of tying together psychology and handwriting. They both require scientific methodology to put them on an acceptable basis rather than be labelled with charges of quacks and frauds which is so often levelled at our profession.

COLE: It seems to me that there is a tendency to place much too much emphasis upon court appearances as if your objective on the first day of the first month of the man's training might be to make him a skilled witness, and I think that is not the proper objective. At the very outset your objective should be to teach a man to make accurate decisions, fair decisions, and that when you are satisfied that he can do that you could then begin to think about training this man for court appearances but not until you are satisfied on that point. Now obviously if you observe that particular routine there are going to be a number of cases where you will train a man to make accurate and useful decisions but you will find that he will not make a good witness, but I say that is simply a chance you have to take in order to keep the best objectives in mind. I think since the study of documents is in itself a specialization, an extreme specialization, that prior to that time, in a man's formal education and his college training, there should not be too much specialization. In other words, I would tend to favour a liberal arts course over a course strongly favouring science.

**Question (2): Should training and qualifications be more standardized and, if so, how might this be accomplished?**

HILTON: I would like to ask a question. How unstandardized are they? That I think perhaps is the point we should try to find out. Are different people trying to train in entirely different way, with entirely different emphasis, or aren't we all really working towards the same end?

BOONE: Since most document examiners do learn by apprenticeship the circumstances surrounding the work which he does and his teacher would be so



vastly different that to set up a specific set of standards to me looks like almost impossible. While we all are trying to arrive at the same end what Mr. Hilton might teach me might be certainly different from what I would learn from Mr. Cole and what I might teach an individual would certainly be different again.

HUBER: Can I put the question to you in this form. Do you feel there is a need to improve the qualifications of a man starting out in document examination work, generally speaking?

PACKARD: I would like to ask how you define qualifications? I do not believe, particularly with handwriting, that there is any science whatsoever involved. You make observations which is common to a science, but therein the parallel with science ends. It is not necessary to have a degree to become a painter. I think there is quite an analogy to document examination in painting. What has emerged so far is that it does not seem to matter where you get your training, particularly in handwriting comparison. I do not think we have agreed on qualifications to start with. Some of us seem to feel that we need a science degree, others seem to think that by studying under an established examiner you can get there, but I think it is quite possible that a person could in fact read Osborn's mighty book and certainly realize literally that they had a flair, an intuition for handwriting comparison.

HILTON: It seems to me that we do have, although we have not defined them tonight, qualifications of a document examiner and I shall attempt to define them rather simply. What we are trying to do in this field with all of our training, individually, with each problem that we examine, is to reach the true facts of the case. There is only one right answer, i.e. "did he write it or didn't he write it?" "Is it genuine or is it not genuine?" and if we reflect on those very simple truths with each problem we have got to realize that there is only one answer. If our qualifications amount to anything it is not what we have done or what we have studied or who we studied with, but are we getting the right answer? Are we determining from the examination of the handwriting that we have before us, the known and the disputed writing, what the facts are? Then we are qualified. If we are doing it each time then I would say we were highly qualified. That is what our training should be directed toward, but I am still somewhat at a loss as to whether our training is unstandardized or not. Mr. Packard mentioned that some people might read Mr. Osborn's book, and I do not know what else they could read to get a full picture of how to identify handwriting as well written as Mr. A. S. Osborn wrote it. If he read the book intelligently, (and that does not mean just reading it once), the basic truths are in there, the basic procedures are in there, nothing is changed since 1910 when Mr. Osborn put that first on paper, as far as identifying handwriting is concerned. But what we are trying to develop is a better training program than sitting down and reading a book.

**Question (3): What other measures, if any, are required to put Document Examination on a more professional basis?**

HUBER: Here again we are confronted with another question which we must answer first, "Is there a need for Document Examination to be put on a more professional basis?"

BOONE: Certainly if we could we might eliminate some of these so-called quacks.

COLE: I think that a small influence towards improving the status of examiners of Questioned Documents perhaps giving them a more professional



status was taken by our Civil Service Commission some years ago when they set up what they call "Standards for the Performance of the Work" rather than standards for choosing employees to do the work, and it runs at a considerable length. They show different grades of work ranging from some of those grades mentioned by Mr. Somerford, GS5 through GS12 or so, and related to that is the writing up of specific job descriptions setting down in considerable detail the various responsibilities that a position has.

HILTON: The American Society of Questioned Documents Examiners, the American Academy of Forensic Sciences and the Document Section within that group are endeavouring through mutual association among examiners to develop higher ethical standards in the profession, and higher technical qualifications of individual workers which, of course, are both essentials of a professional basis. They are trying to lift the status of the work, not only among the members of these organizations but among all workers in the field. There are a group of examiners around the country that are not nearly so dishonest as they are ignorant and I am afraid that those, for the most part, are ones that are working outside of governmental agencies.

HUBER: I wonder if some of the experience of other professions is a matter which we might consider. For example, the medical and legal professions which have within their professions certain controls which prevent intrusions into these fields by lesser or unqualified individuals.

BOONE: It would be a desirable thing to have such a minimum of qualifications laid down by law, something like the Civil Service requirements, but could you get that in a state where 99 percent of the people never heard of a document examiner?

COLE: I think we are considerably handicapped by numbers, that it would seem a rather odd thing, to have an association with was confined to small numbers, in relation say to lawyers and doctors, which attempted to set up qualifications for understudies, though I think it is desirable to even on a small scale.

### **Discussion open to the floor**

GODOWN: I think a part of the difficulty with the problem we are discussing here is that qualification is a "multi facets" subject. You can think of it in terms of perhaps four definitions. We appear in court a portion of the time as expert witnesses and the test of qualifications of an expert witness in most courts is whether or not there has been a sufficient show of special knowledge over and above the ordinary man to receive what he says as an opinion for what it may be worth of which in a Tennessee case it was said, "Which we deem very little in our appeal". The average judge is not interested in your real technical qualification, he is interested only in whether you have a sufficiently better experience than the average man on the street, that he should admit your testimony for what it may be worth. The second type of qualification is one that is persuasive to the trier of fact, that this person really knows that whereof he speaks. Another one is that qualification which is sufficient to convince the perspective client or the employer or the immediate superiors that this person knows whereof he speaks. The fourth one is the one that we are really concerned with in much of the talk here, "Does the person sufficiently know about the subject to arrive at the correct answer the greater part of the time?" There is where the difficulty comes when you start talking about what is adequate qualifications. I have seen many men with a minimum of qualifications testify. The graphologists say, yes they are handwriting experts, so the

testimony is in. I have seen many people that had many degrees, who made a beautiful appearance as far as persuading the jury that they knew what they were talking about, that really had no ability at all to arrive at the right answers, but it was very persuasive. They were there to make a nice appearance, they had beautiful silvery hair, a good goatee and a nice courtroom presence and they were very successful. Those same people that attract clients usually keep their superior pretty well convinced as to being excellent witnesses and how highly qualified they are. That is the difficulty we face in deciding what is adequate and proper qualification. The real test is as has been stated, "Is this the right answer and do I reach it consistently?" But this is not what shows up in Court.

McNALLY: The American Academy has established as any profession has to, a code of ethics. All professions necessarily have a code of ethics, even we ourselves do have a code of ethics, but the fact is that there are people who will just pay lip services to it. I feel as far as professionalization is concerned there would have to be some sort of a licencing set up, a code of ethics and some sort of a licencing arrangement of some type where you have to meet a set of qualifications or some type of examination.

PURTELL: In the state of Illinois a few years ago a police captain, Capt. Hall, when he was on the examining board of the state for issuing private detectives' licences, wanted to have document examination, lie detection and firearms and if he could the other forensic sciences come under the private detective act where they would have to pass an examination and put forth their qualifications before the board and be granted a private detective's licence to practice as document examiners, etc. Some document examiners opposed it and Capt. Hall figured that if they did not want it he would not push it. It was at least a move to eliminate the unqualified in the state.

# Causes and Effects in Penmanship

FRED D. RICHARDSON  
High School of Commerce  
Ottawa.

## *Abstract*

This paper discussed bad writing habits and their effect in the written product. The corrective measures adopted by current teaching techniques were described. Examples were drawn from Mr. Richardson's several years experience as a teacher of penmanship in Ottawa's High School of Commerce.

Mr. Richardson reviewed the progress of specific students in penmanship practice, dealt with the left-handed writer and mentioned the various individuals who have headlined the teaching of handwriting in Canada in recent years.

## Discussion of Mr. Richardson's paper

SMITH: There are text books I think which point out the physical things that a writer does that causes certain peculiarities in handwriting. You are interested in overcoming those faults to improve his handwriting, we are interested in those very things for identification purposes. Can you refer us to any of the books that would cover that form of instruction?

RICHARDSON: There is only one book which has illustrations that show what fault it is and what caused it. That book is the teacher's manual for the McLean system of penmanship, written by H. B. McLean in Vancouver. The Zaner Blozer people have something on it, but their system is more for the younger children.

SMITH: In your penmanship studies, have you gone into the physiology of left handed writing, and the causes therefor.

RICHARDSON: No, I am almost as bad as the Russians. In Russia, no child is allowed to write with anything but his right hand.

WRENSHALL: Do you know if the Ottawa public schools adopt any particular procedure in connection with the lefthanded writers? Does the teacher, for example, place the book in a certain position?

RICHARDSON: I think the expression is "laissez faire". There are good left handed penmen, but it is generally pretty tough writing inside out and backwards.

SMITH: Have you had any experience with mirror writers?

RICHARDSON: Occasionally, yes. We are in business school and kind of hard boiled. We like them to change and conform. Some of the most brilliant minds in history were left handers. Leonardo da Vinci was a left hander and a mirror writer.

HUBER: As one who teaches handwriting, and who follows the Bailey system, I wonder whether you have noticed any significant difference between the various systems of writing that are taught, and what features of the various systems you might find carried over into the normal writing of the individual

in later years. Are there any specific distinctions in the various writing systems with which you have come in contact that have some form of identity in their use later on?

RICHARDSON: The Zanerian system which has sold very successfully in the United States has a characteristic spacing. Take "m" and "i". You turn it upside down and it makes "n" and "u". The Bailey system, which is a Canadian version of the Mills system in the United States which we consider the most accurate of them all and the most practical for senior students, has extra wide spacing, the letters stand out by themselves and if you turn that upside down of course that does not make "n" "u" but if you turn this upside down this other fellow should. (demonstrating).

SMITH: Have you noticed any relationship between the styles of writings of your pupils and their apparent personalities for example the ostentatious ones, the subdued and retiring person and so on?

RICHARDSON: No, I have not. I believe the graphologist is way ahead of us. The graphologists say people who write backhanded tend to be hard to get along with. Certainly reading backhanded writing is hard to get along with, but that is the extent of what I say on the subject. By the way, we find that the most of our best writers at the end of a course, come from those who are at the bottom of the list when they started.

HUBER: What period of time do you think it would require for an individual with concentrated training either under direction or by his own volition to completely alter his writing either to a more closely resembling copybook style or to some other system of writing?

RICHARDSON: With the school children who are there under duress, go to school or go to jail sort of idea, 200 hours. 100 hours for an adult produced amazing results in the writing of a left handed person. You can alter your blackboard writing in a very few hours. George Tanako, one of the best penmen in Hawaii made a phenomenal change in his writing in ten weeks. It takes longer with pen, on the blackboard it is relatively quick.

SMITH: In the study of handwriting, we are concerned with the implement being used, the pressure applied to the paper, the slope of the pen, the slant of the writing, etc. Have you noticed a perceptible difference in the writing of a person on blackboard writing and his paper writing?

RICHARDSON: Yes, it is much easier to write on the blackboard.

SMITH: But, in the style and form of the letter are there strong correspondence between the two, in other words, if we gave you a sample of our paper writing, and we each wrote on the blackboard would there be very close correspondence in the appearance of the writing with the exception of the size.

RICHARDSON: I would have to ask you experts about that because we just simply do not have enough time to do blackboard work, have the pupils do it as we should. There is this difference that when you write on the blackboard you are using arm movement, in fact you are using whole arm movement, whereas on the desk you rest your arm and some rest their fingers and their knuckles and it does cause a cramping of the writing. In our own, we of course try to write the same on both.



# Psychological Studies in Handwriting

D. M. DUKE

R.C.M.P., Crime Detection Laboratory  
Ottawa.

To the qualified and competent document examiner, the terms "graphology" and "psychology of handwriting" are frequently rather distasteful, generally eliciting a response somewhat akin to that expressed by a person finding half a worm in half an apple! This attitude is particularly prevalent among document examiners on this continent, and perhaps is justified to some extent when considered in the light of past experiences.

For many years the pioneers in our field had to battle well-established public prejudices before handwriting evidence became generally accepted by the courts. Though progress has been made to the point where the submission of such evidence in civil and criminal cases is not uncommon, there is still a great deal of education and familiarization with our work yet to be undertaken amongst members of the legal fraternity. Even today we are constantly confronted by the criticisms that handwriting identification is not really a science, or that one "expert's" opinion is just as good as another's.

There is no doubt that our task has not been made easier by those operating under the guise of psychologists who have sought to capitalize on the public's lack of information or critical thought. These fortune-tellers purport to be able to determine a person's character or to diagnose specific physical ailments through the interpretation of certain signs or symbols which are found in an individual's handwriting. There is no question that many of these have been extremely successful financially. Apart from a discussion of the ethics of such practices, possibly the greatest damage has been done by such persons when they have appeared before the courts as expert witnesses. On some occasions, they have given evidence regarding the genuineness or otherwise of disputed writings when not qualified to do so. Evidence of this sort, which is not infrequently in error, has led to skepticism in many courts and a marked reluctance to accept with an open mind any handwriting evidence whatsoever, regardless of the nature of the evidence or of the professional standing of the truly qualified expert presenting such evidence.

I think it is understandable therefore why so many qualified document examiners generally regard with disdain any handwriting study which is associated with graphology or psychology. Almost daily we are confronted with the results of allegedly scientific studies in newspapers, magazines, periodicals and books. We can even enroll in correspondence courses that will teach us the fundamentals of this pseudo-science. To combat this current popularity, we have refused to recognize all psychological studies of handwriting, stoutly declaring meanwhile that handwriting identification and graphology are worlds apart, that the latter is not founded on scientific principles, and that all who practice it are cheats, liars, and frauds. We tend to regard ourselves as the purists, the "lily-whites", and wonder why others are not perceptive enough to appreciate our rigid scientific procedures to the exclusion of the arguments of the graphologists.

But in declaiming psychological studies of handwriting, are we being completely unbiased? Do we possess enough knowledge of psychological principles to make a fair judgment? By upholding our own profession so vigorously, have we closed our minds to the possibility that others may also deal legitimately with the same subject matter but by different techniques and for different reasons, even while finding the study of handwriting personally satisfying and rich in potential? It is possible that we as document examiners have become so imbued with the spirit of advocacy for our own profession that we do not realize that honest efforts are being made by many psychologists to determine whether or not handwriting does in fact provide another means by which the personality traits of an individual may be determined.

Unfortunately, any professional group has its "mavericks", and it seems that the fields of both psychology and forensic handwriting identification attract more than their fair share of those who trade on the capabilities and accomplishments of genuinely outstanding men to further their own selfish ends. The ones who identify themselves with the psychological aspects of handwriting have already been mentioned. In our own sphere we have a comparable fringe area where men of equally dubious professional standards operate, whose actions reflect upon the integrity of document examiners generally and who frequently cause a difficult task to be made more difficult. These are the ones who are not adverse to colouring their reports or their evidence to suit the needs of a client, or who, through indifference, inexperience, or lack of appreciation of scientific methodology, arrive at erroneous conclusions. That such persons are accepted by the courts as expert witnesses points up the fact that there is much education of bar and bench yet required.

However, the point I wish to make clear before proceeding further is this—that the standards of any particular occupation or profession, be it medicine, law, psychology, or document examination, should not be judged by the independent actions of a few. We know that document examiners as a group are often criticized because of the errors of a few incompetents; let us not fall prey to the same fallacy of generalization by regarding all handwriting studies by psychologists as the work of quacks! Many worthwhile projects pertaining to handwriting have been undertaken by psychologists; not all have a direct application in the forensic field, but each adds something to the total store of knowledge of a subject with which we are all vitally concerned.

We of course are all aware of the individuality of handwriting from the forensic standpoint, and I do not intend to delve into what may be termed the philosophy of identification for that reason. There are, however, one or two points concerning the psychological approach to handwriting which may profitably be discussed, giving specific attention to the study of handwriting as an expression of personality. This is what I consider to be graphology, though through indiscriminate usage the word has come to have undesirable connotations. And I wish it to be understood that I do not pretend to be an expert in psychology—far from it—but I think that the following points will be generally considered to be fairly representative of current psychological thought on the subject.

Broadly speaking, psychology is the study of human behaviour, or what is more or less characteristic of all human beings. The study of personality is more specific, and is concerned with the characteristics that distinguish one person from another. All the separate abilities, attitudes, physical characteristics, and aptitudes that serve to individualize a person are personality characteristics and psychologists are constantly looking for methods which will assist in attaining a fuller understanding of personality. Studies (6) have shown that individual differences appear quite markedly in a variety of

physical activities such as walking, speaking, gesticulating, standing, drawing, painting, and of course handwriting. The intent of some of these movements is quite apparent as, for example, the wave of the hand or a nod to an acquaintance is intended as a greeting or simply as recognition. Other activities are not so readily interpreted and may have significance only to the person himself. Tugging at an ear, for example, may mean only that the ear is itchy, but if this act is habitual it may imply puzzlement or bewilderment, in which case it becomes an "expressive" movement. It is this type of movement which many psychologists consider handwriting to be. Putting words on paper requires certain co-ordinated movements which are prescribed by the system of writing learned, but it also allows for a certain individuality of style in the execution of the words and letters. This individuality of writing is therefore of interest to the psychologist engaged in a personality assessment, and to the document examiner in proving identity or non-identity of two writings.

Psychologists themselves vary in the significance they attach to handwriting as a projection of the personality. Some believe it to be the means by which a person's innermost feelings are manifested. Others more cautiously regard it only as one of the many possible ways of studying personality, no one of these methods being sufficient by itself but all combining to produce a reasonably complete picture of the various traits which typify an individual. However, it is evident that some gross clues to personality pattern are often provided by a study of a handwriting. For example, many anonymous letters come into the possession of law enforcement agencies which can quite reasonably be recognized as the product of a mentally deranged author, apart from a consideration of the subject matter of the letter itself. And in many clinical diagnoses psychologists may refer to a study of the patient's handwriting, along with other diagnostic procedures, in an attempt to determine the nature and extent of the patient's mental disturbance.

I mentioned earlier that many psychologists have carried out surveys or experiments in connection with handwriting which incidentally have furnished information of interest and possibly of value to the document examiner. Several of the studies I have come across have a direct bearing on our work; the others are presented here purely as a matter of interest to illustrate that some work has been done in the field of psychology on problems we may have wondered about but which have not been of such immediate concern to warrant a special study being undertaken.

The first of these studies concerns the identification of one's own handwriting and the factors involved in such as identification. This experiment was conducted by M. E. Tresselt of the Department of Psychology, Hunter College, N.Y., the results being published in 1946 (7). The object of the test was to determine with what degree of accuracy a person could recognize his own handwriting over a period of time ranging from one to nine weeks. A total of 180 subjects were tested during this time. At the beginning of the experiment, each was required to write a short composition on an assigned topic. The experimenter then made both traced and freehand forgeries of these compositions and the subjects were required individually to select their own handwriting from a sheaf containing at least 100 other papers also used in the experiment. Correct judgments over the nine-week period averaged only 32.46 per cent, a result which appears astonishingly low considering that these subjects were identifying only their own handwriting. Of the factors involved in these identifications, 65 per cent of the subjects were guided by general appearance, 56 per cent by the content of the documents, and 24 per cent by whether ink or pencil had been used. Of factors inherent in the writing itself, 30 per cent considered certain letter formations, 19 per cent



the size of the writing, and 16 per cent the slant. The results of this experiment point up most dramatically, I think, a fact of which we are all aware—the grave danger of allowing lay witness identification of handwriting in the courts.

Another experiment published in 1945 (2) tested the ability of both men and women to judge the sex of a writer from the handwriting. Florence L. Goodenough of the University of Minnesota obtained specimen writings from 115 high school students of both sexes and submitted these to ten male and ten female “non-expert” judges. The sex of the writer was judged correctly in 69.6 per cent of the cases, the women judges showing a slight, but not significant, superiority in correct identifications. Constable J. H. Hodgins of our R.C.M.P. Laboratory staff conducted a similar experiment this year using both expert (i.e. qualified document examiners) and lay judges. His results showed the sex of the writers was judged correctly 65 per cent of the time, very close to the results obtained by Goodenough. There was no significant difference in the abilities of experts and non-experts in this task.

Albert Rabin of Michigan State College and Harry Blair of the Beatty Memorial Hospital, Westville, Indiana published their results of a third very interesting study in July, 1953 (5). Their experiment dealt with the effects of alcohol on handwriting and involved forty normal male subjects between the ages of 22 and 40 years who were all moderate social drinkers except two. These latter two were classed as heavy drinkers. The forty subjects consumed between 9 and 15 ounces of 100 proof bourbon whisky over a 4½ hour period in a social setting, i.e. chatting or playing cards. The handwriting task consisted of writing a given text on 8½" x 11" sheet of paper and signing it, both before and after the 4½ hour test session. On the basis of several handwriting features which were easily subjected to measurement, significant differences were noted in the before- and after-drinking writings. Significant increases were noted in the following features after the consumption of alcohol: total time required to execute the written text, the space left for the top margin, the total length of lines, the total number of lines, the number of gross errors, and the number of open “a’s”. Significant decreases were noted in the width of the left-hand margin, but none in the right-hand margin. The signatures showed a significant increase in length, and the average size of both small and capital letters in the signature increased. No significant increases or decreases were noted in the number of “i’s” dotted, the number of “t’s” crossed, or the number of open “o’s”.

Another interesting aspect of this experiment was that four judges who were graduate students in psychology and four others who had no specialized training in graphology judged which sample of each of 28 pairs of writing was obtained before alcoholic consumption with an accuracy of 96 per cent. Two judges were 100 per cent accurate, and no judge made more than two errors. These judgments were made on what were termed “global impressions” of the writing samples. The experiment stated that “in most cases the effects of the alcohol were obvious and readily noted in the disorganization of the handwriting sample”.

Still a fourth pertinent study on the relation of writing speed to age and to the senile psychoses was conducted by James E. Birren and Jack Botwinick in Baltimore, Maryland, and was published in 1951 (1). The primary purpose of their work in this regard was to determine whether tests of writing speed would be useful in the psychological examination of the older person. Their



experiment indicated that this would be so. A necessary part of this study was the determination of average writing speeds for a wide range of age groups, and this portion is of interest to document examiners. It was found that the average speed of writing both digits and words in 554 subjects ranging from 16 to 89 years of age decreased markedly after the thirty-ninth year and at almost a constant rate. The average number of digits written per second was 1.67 for the 16 to 20 year age group, and only 0.49 for the 80 to 89 year age group, or less than one-third of the speed. For words, the average number of words written in two minutes ranged from a high of 48.0 for the 20 to 29 year age group to a low of 15.2 for the 80 to 89 year age group, again less than one-third of the speed. When 35 patients with senile psychoses, i.e. mental deterioration due to old age, were compared with the general population of the same age, the senile patients were seen to be significantly slower for both forms of writing.

In addition to the above reports, I have noted several items in "Psychological Abstracts" which may be interesting. One of these is a study concerning twin differences in writing performance published in book form in Sweden (3). The author investigated genetic and environmental variation in the school handwriting of 530 pairs of identical and fraternal twins aged 8 to 15 years. After four additional years of schooling, some pairs were tested to see whether environment had any influence on the handwritings, and it was noted that the handwritings of the twins tested had increased in similarity. A similar study of the writing of identical and non-identical twins reviewed in "Psychological Abstracts" (4) disclosed that the writings of identical twins were no more similar than the writings of fraternal twins, indicating that individual differences in handwriting are hereditarily determined to only a small degree. Lacking the original literature in these two instances, I was unable to determine what each of these authors meant by the term "similarity", or to just what extent the similarity was noted. These would have to be defined more precisely before any concrete conclusions could be drawn from these excerpts.

As you can see from some of these psychological experiments or surveys I have presented here, there is no doubt that the science of psychology can offer much to handwriting identification, both as to information and to methodology. It is granted that many psychologists commit an error which is fatal to any scientific investigation—they formulate conclusions which are beyond the data at their disposal. But psychologists are not unique in this respect. Document examiners too sometimes arrive at conclusions which are not in accordance with the evidence before them. Any scientific endeavour necessitates a logical precision in thinking and a casting aside of preconceptions and prejudices.

It may be argued that psychology is not exact, that personality cannot be definitely determined from handwriting. After all, sex can be determined correctly in only two-thirds of the cases, and what greater distinction in personality can there be than to distinguish between masculine and feminine? But the word "science" does not necessarily imply exactitude. Mathematics and its symbolism is probably closer to being an exact science than any other. I believe that any scientific theory represents only a better approximation of the specific process under investigation, and that so long as we are steadily approaching the truth rather than moving farther away, criticisms of inexactitude are unwarranted. Each new theory should be considered in the light of the facts, and if the two do not coincide, then it is the facts that should reign, and not the theory.

## BIBLIOGRAPHY

1. Birren, J. E. and Botwinick, J. "The Relation of Writing Speed to Age and to the Senile Psychoses," *Journal of Consulting Psychology*, XV, 3 (June, 1951), 243 - 249.
2. Goodenough, F. L. "Sex Differences in Judging the Sex of Handwriting," *Journal of Social Psychology*, XXII, (1945), 61 - 68.
3. Norinder, Y. "Twin Differences in Writing Performance; A Study of Heredity and School Training," *Psychological Abstracts*, XXII (1948), 4104.
4. Ostlyngen, E. "On Hereditary and Environmental Determination of the Variability in Handwriting—A Study of the Handwriting of Twins," *Psychological Abstracts*, XXI (1947), 2597.
5. Rabin, A. and Blair, H. "The Effects of Alcohol on Handwriting," *Journal of Clinical Psychology*, IX, 3 (July, 1953), 284 - 287.
6. Stagner, R. *Psychology of Personality*. Toronto: McGraw-Hill Book Co., Inc., 1948.
7. Tresselt, M. E. "A Study of the Factors in the Identification of Handwriting," *Journal of Social Psychology*, XXIV (1946), 101 - 109.

## Discussion of Mr. Duke's paper

WRENSHALL: The question of psychology came up last night and the attitude of almost everyone seems to be that psychology is psychology of personality and that psychology of handwriting deals with personality. Now there is a facet of psychology, and there is more than one facet in psychology, which has not been mentioned and that is the visual-motor field of psychological study. I think, that this most closely concerns document examiners and their study of handwriting because the visual-motor field is where we get our handwriting execution. Everyone knows that handwriting is brain writing in the sense that you can express yourself through handwriting, but actually it is a mental expression executed through a motor facility. Visual-motor difficulties and the effect on handwriting was very pointedly brought home to me in the case of a person who died very suddenly from a brain tumor. Prior to his sudden demise there was a marked deterioration in his handwriting capabilities and I submit that this was very probably a visual-motor difficulty and for that reason this field of psychology should concern the document examiner closely.

DUKE: I did not intend to pass on the erroneous conclusion that I felt we should all turn around and study handwriting as a projection of the personality. I merely wished in a portion of the paper to point out the attitude that many psychologists have towards this and the line of reasoning they follow. I do not think necessarily that we should all become conversant with psychology and personality and personality diagnostic procedures to perform any particular examinations in our own laboratories.

COLE: I should like to comment that a statement about the impossibility of reading character from handwriting is not necessarily a statement that some information about personality is not in the handwriting. I think you have to regard it more as a statement that we do not yet have sufficient means for reading those signs of personality if they are there.

HILTON: I want to congratulate Mr. Duke on coming forward with this paper, because in some ways I feel that it is a guiding light toward what might be done in the future. The feeling that document examiners have about psychology stems to a very large measure, (1) from a smattering of ignorance on the part of many workers in the field as to what psychology is trying to do, (2) the early leadership of men in our own field who were outstanding but knew very little about psychology and (3) the fact that the field of psychology has grown so tremendously and made very great strides within the last

50 years. This is a phase of work which should be explored much more than we have done. We could do very well to become somewhat more conversant with the psychologist's problems and try and get him more conversant with some of ours because certainly these papers that have been cited here have a bearing on what we are interested in. Whether they are all that could be done is another question, but they are a start and if we can get people that are interested in research in the field of psychology to work on these things, perhaps in co-operation with us, I think we would be gaining a great deal. This is the same general theme of the American Academy of Forensic Science, in endeavouring to find the inner relationship between various fields of forensic science but I don't think it needs to stop there. Other academic fields can be of tremendous help to us and I hope that this leads to something more.

McCARTHY: With respect to sex predictions you can take two viewpoints. You can say that we can only predict the sex of the writer 66 per cent of the time, but you can also say we have made a great advance because we can predict it 16 per cent of the time greater than that expected by chance. I might point out without being too facetious, that there is not too great a difference between the sexes, in other words there is a gradual diminishing from what we call masculinity to femininity. Therefore, if we can predict sex 16 per cent of the time more than that expected by chance I think we are doing pretty good.

DUKE: I will bow to higher learning in the psychological field than myself Mr. McCarthy. The head of the Department of Psychology at Carleton University seems to consider that sex is one of the greatest distinctions that can be made, and I think it just brings home the fact that even within the field of psychology itself there is not entire agreement as to what aspects can correctly be considered or what methods can be used in personality studies of handwriting.

# The Left-Handed Writer

A. ZITZELSBERGER

R.C.M.P. Crime Detection Laboratory

Regina

(Read by C. C. Head)

This paper is intended to discuss the left-handed writer, the methods of writing employed by the left-handed writer and his handwriting as compared with the handwriting of the right-handed writer.

In the past, it was the custom to attempt to force the left-handed child to write with his right hand. This practice, I am led to believe, has been continued in various European countries until very recently. It is now held that in forcing the left-handed person to write with his right hand, the writer does not in later life reach the point where he can write with speed and ease. It is also claimed that the speech centers of the brain are closely related to those associated with the act of writing and forcing a left-handed child to write with the right hand can result in disorganization of the speech center, leading to poor expression of thought and confused thinking as well as a lowered ability to write. The rule, in general, today, is that the left-handed writer should not be forced to write with the right hand.

Enquiry among approximately 200 members in training at the R.C.M. Police, Regina "Depot", revealed ten left-handed writers. Among these, none was found to be ambidextrous. These ten left-handed writers represented individuals educated in the provinces of Canada from the East to the West Coasts.

Specimen handwriting was obtained from these writers and from various other left-handed writers for examination, and in order to observe their methods of writing.

It was found that the left-handed writer employed two basic writing positions.

(a) (Method (a)) Plate I. The paper is placed with the longitudinal axis passing to the right, that is, the paper is placed in the same relative position to the body as it is placed by the right-handed writer. This forces the writer to adopt an extremely awkward appearing pen grasp. The writing hand is above the line of writing. The advantage of this position to the writer is that it enables him to see his product.

(b) (Method (b)) Plate I. The paper is placed with the longitudinal axis to the left side of the writer. The pen grasp and writing position is comparable to that of a right-handed writer. In this position, the writer is not able to see what he has just written.

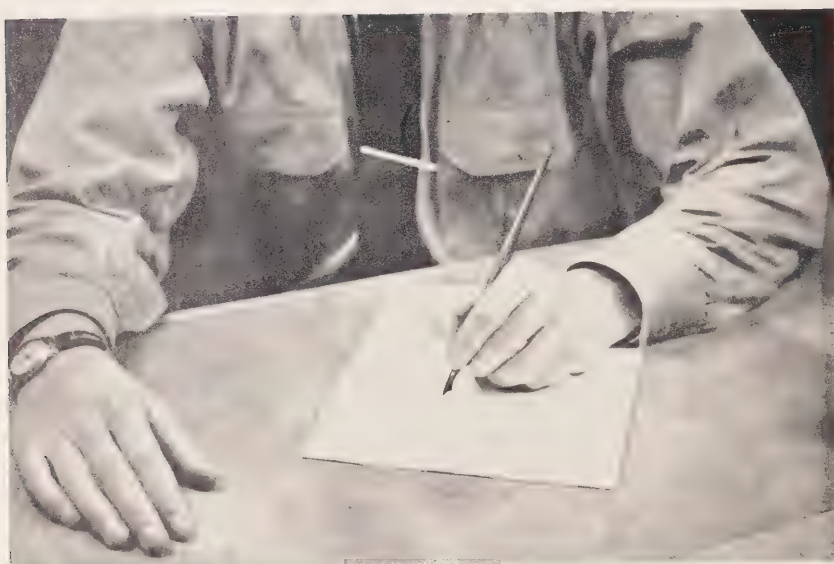
In the group of ten members in training, it was found four employed position (a) and the remainder, position (b). The adoption of method (a) or (b) by the left-handed writers did not appear to be influenced by geography.

None of the writers interviewed could recall any special consideration given by his teacher to the question of writing with the left hand, that is, from the point of view of position of the paper, pen grasp, etc. All maintained that their method of writing was a matter of their own choice.





Method (a)



Method (b)

Plate I

The writers examined were found to be left-handed to varying degrees. One writer used his left hand only to write, and employed his right hand in all other activities. The handwriting of this person is very well coordinated and highly skilled. Method (a) of writing was employed. The majority of the left handed writers were left-handed in the greater part of their activities, but were right-handed to some degree. A few of the writers stated that they were totally left-handed and did nothing in which the right hand was predominant.

Some of the writers had been subjected to attempt, by their teachers, to change to their right hands, when learning to write. One individual was forced to write right-handed for two years, while others were induced to write with the right hand for lesser periods. It was observed that these writers, all at maturity, did not disclose greater proficiency in writing with the right hand than did those who had not been induced to change. It was also observed that the left-handed writers, as a group, did not disclose greater proficiency writing with their right hand than do right-handed persons writing with their left hand. One writer, a left-handed person, who had been converted to the right hand was encountered. This person had written predominantly left-handed to the age of 10 or 11 before being forced exclusively to the right hand, and was capable of writing with either hand. The right hand was more proficient, however, due to practise.

The fact that the writing is written by a left-handed person is not self evident or readily recognizable. Features such as slant, writing quality, skill, size, proportions, roundness, angularity, alignment, letter forms, connections, terminal strokes, etc., vary from writer to writer and do not offer any persistent deviation from right-handed writing, which would distinguish it as being the handwriting of a left-handed person. Examination of the writing line in reference to the location of pressure or line emphasis and the location of shading does, however, provide the means by which it can be discerned whether a specimen of handwriting is written with the left or right hand.

The writing of a left-handed writer employing method (a) of writing is the most readily recognizable. In this case, the location of pen pressure and shading is most removed from that found in right-handed writing.

In writing written with the right hand, (Chart No. 1) Plate II, the greatest emphasis is on strokes which travel downward in a left to right direction. Observe the down stroke in the letters "i", "d", "r", and "e" and the terminal strokes in the letters "G", "I", and "H". The extent of pressure and shading, the points of commencement and termination, are, of course, variable and individual to the writer. This individuality naturally applies also to the writing of the left-handed writer.

(Chart No. 2) This illustrates handwriting written by a left-handed writer, employing method (a). In the first line are illustrated letters which disclose greatest line emphasis in the same relative position as is found in right-handed writing. This was found common to these writers and present the danger of misleading the examiner. The strongest line emphasis, however, occurs, as can be expected, in view of the position of the hand and pen to the paper, in horizontal strokes which are in a right to left direction, particularly those which angle or turn upward. In line two of the chart these can be seen in the right to left stroke commencing at the base of second down stroke in the letter "H" or in the initial stroke in the letter "J". These strokes readily differentiate the writing of a left-handed writer employing method (a) from that written by a right-handed writer.

In the writing of the left-handed writer employing method (b) (Chart No. 3), the differences between right and left-handed writing, with respect

RIGHT HAND

red, re  
40. 20.

CHART NO. 7

LEFT HAND "B"

cents zone city

zone of edge

CHART NO. 7

LEFT HAND "A"

— — —

— — —

CHART NO. 7

Plate II

to pressure and shading, is often much more subtle and not easily recognizable. Pen pressure and shading consistently occurs in relatively the same location in both the right and left-handed writing. In Chart No. 3 observe the down strokes in the letters "c", "e" and "o". The differences in pressure and shading occur in downstrokes which are vertical and, in particular, those which angle slightly back to the left. The pressure in this case is greater and of longer duration than that in a comparable stroke written by a right-handed writer.

It was also found that among the left-handed writers employing method (b), the great majority wrote a vertical style of writing or wrote with a back slant. A very significant feature of the method (b) handwriting is the direction of the "t" crossing. In each case it was found the letter is generally crossed from right to left.

In summation, this study of the left-handed writer has disclosed that of the group of 200 men observed, approximately 5 per cent were left handed.

Further, that the left-handed writer, in a predominantly right-handed world, does not display a greater skill in the use of his right hand, in so far as writing is concerned, than does a right-handed person attempting to write with his left hand. Nor did efforts to induce the left-handed individual to write with his right hand in the early stages of his writing development influence his ability or rather inability to write with his right hand in later life. The one example of a left-handed person who had been converted to a right-handed writer disclosed ability to write with the left hand even though unpractised.

The study of the handwriting of the left-handed writer has shown that his writing is not self evidently left-handed writing. The qualities of skill and speed, the features of slant, size, proportions and alignment do not distinguish it from right-handed writing. The employment of the magnifying glass and stereomicroscope, and thorough examination of all the writing lines are the means by which the left-handed writer, employing either method (a) or method (b), can be discerned.

In conclusion, I would like to illustrate the handwriting of the left-handed person who was converted to a right-handed writer.

This individual, a woman, did not have the opportunity to obtain a formal education until the age of ten. Her education, prior to this age, had been received from her mother. In this period, she wrote with both her left and her right hand. Her left hand by choice, and her right hand because her mother wished it. After the age of ten, the writer attended school and was forced to write exclusively with her right hand. This is the hand presently employed in the act of writing. The writer, is however, left handed in all other activities. The specimens of handwriting, I am sure, you will find interesting.

First illustrated is handwriting written with the right hand. (Plate III). The writer writes with fair speed. The handwriting is individualistic, neat, pictorially pleasant and executed with coordination and skill.

Next illustration is handwriting written by this person with the left hand (Plate III). The handwriting, as it is little practised, is written rather slowly. Method (b) of writing was used. It is essentially a disconnected script.

A comparison of these right and left-handed writings discloses general handwriting similarities. There are however, a large number of consistent differences and variations which would prohibit a positive conclusion of common authorship. Most apparent, of course, is the change of slant and the disconnected script of the left-handed writing. Observe also the address and date in the upper right hand corner. The right-handed writing places the address in "step" form while in the left-handed writing, the address is in block form. Various letter formations are also found to display a decided



The Canadian village

1920 2nd year

1920 3rd year

Dear & kind of summer,  
of Gold Medal Tropical X Co. and the

Canadian village

1920 3rd year

Dear Mr. and Mrs.

holiday village, I am very glad to hear of the  
results from the 1st year of the  
to which you have been so kind to  
we wish to hear of the results of the  
I know that you are very  
happy, and we are very  
glad to hear of the results of the  
X-ray gold to receive a letter from

1920 3rd year

The Canadian village

1920 2nd year

1920 3rd year

Dear & kind of summer,  
of Gold Medal Tropical X Co. and the

Canadian village

1920 3rd year

Dear Mr. and Mrs.

holiday village, I am very glad to hear of the  
results from the 1st year of the  
to which you have been so kind to  
we wish to hear of the results of the  
I know that you are very  
happy, and we are very  
glad to hear of the results of the  
X-ray gold to receive a letter from

1920 3rd year

difference. For example, the letter "f", the reverse curve produced in forming this letter is totally opposite. It will be also noted that the loops which project below the writing such as in the letters "f", "j", "y" and "g" are closed or turn in opposite directions. Those written with the right hand are closed to the right while those in the left hand writing hook to the left.

These specimens of left and right-handed writing written by the one and the same person illustrate very strikingly the necessity, in some cases, of ascertaining whether a questioned handwriting is written with the left or right hand and whether a suspect is ambidextrous.

#### "MIRROR" WRITING

#### PHOTOGRAPHIC REVERSAL

#### Plate IV

Finally I would like to show you a further specimen of handwriting by this writer (Plate IV). This interesting specimen of handwriting is a "mirror" writing, written with the left hand. Method (b) is employed. Although this writing is not rapidly written, the speed with which it is performed is surprising. The individual practised this writing as a child and particularly in school while being forced to write exclusively with the right hand. It developed as a form of entertainment.

A photographic reversal of this writing is most interesting when it is compared with the writer's normal left and right-handed writing (Plate V). Examination discloses, that, while written with the left hand, it is most similar to that written with the right hand. The reversed mirror writing and right-

as was expected, a good one. My American relatives following  
 around with the Black Army at the front near the 8-6 R. R.  
 They are surrounded by Chinese and Russian soldiers as they  
 are. But the Chinese and Russian soldiers are not the same as the  
 Chinese in Russia. There is not the same kind of spirit,  
 will to win as of fighting as they in Japan. And  
 because of this time of war here, in 1917 - before  
 when the war started, and it was not possible for the  
 soldiers to be in a position

# "MIRROR" WRITING - REVERSAL

the Chinese soldiers  
 1917, 1918, 1919, 1920  
 1921, 1922, 1923, 1924  
 1925, 1926, 1927, 1928  
 1929, 1930, 1931, 1932  
 1933, 1934, 1935, 1936  
 1937, 1938, 1939, 1940  
 1941, 1942, 1943, 1944  
 1945, 1946, 1947, 1948  
 1949, 1950, 1951, 1952  
 1953, 1954, 1955, 1956  
 1957, 1958, 1959, 1960  
 1961, 1962, 1963, 1964  
 1965, 1966, 1967, 1968  
 1969, 1970, 1971, 1972  
 1973, 1974, 1975, 1976  
 1977, 1978, 1979, 1980  
 1981, 1982, 1983, 1984  
 1985, 1986, 1987, 1988  
 1989, 1990, 1991, 1992  
 1993, 1994, 1995, 1996  
 1997, 1998, 1999, 2000  
 2001, 2002, 2003, 2004  
 2005, 2006, 2007, 2008  
 2009, 2010, 2011, 2012  
 2013, 2014, 2015, 2016  
 2017, 2018, 2019, 2020  
 2021, 2022, 2023, 2024  
 2025, 2026, 2027, 2028  
 2029, 2030, 2031, 2032  
 2033, 2034, 2035, 2036  
 2037, 2038, 2039, 2040  
 2041, 2042, 2043, 2044  
 2045, 2046, 2047, 2048  
 2049, 2050, 2051, 2052  
 2053, 2054, 2055, 2056  
 2057, 2058, 2059, 2060  
 2061, 2062, 2063, 2064  
 2065, 2066, 2067, 2068  
 2069, 2070, 2071, 2072  
 2073, 2074, 2075, 2076  
 2077, 2078, 2079, 2080  
 2081, 2082, 2083, 2084  
 2085, 2086, 2087, 2088  
 2089, 2090, 2091, 2092  
 2093, 2094, 2095, 2096  
 2097, 2098, 2099, 2100  
 2101, 2102, 2103, 2104  
 2105, 2106, 2107, 2108  
 2109, 2110, 2111, 2112  
 2113, 2114, 2115, 2116  
 2117, 2118, 2119, 2120  
 2121, 2122, 2123, 2124  
 2125, 2126, 2127, 2128  
 2129, 2130, 2131, 2132  
 2133, 2134, 2135, 2136  
 2137, 2138, 2139, 2140  
 2141, 2142, 2143, 2144  
 2145, 2146, 2147, 2148  
 2149, 2150, 2151, 2152  
 2153, 2154, 2155, 2156  
 2157, 2158, 2159, 2160  
 2161, 2162, 2163, 2164  
 2165, 2166, 2167, 2168  
 2169, 2170, 2171, 2172  
 2173, 2174, 2175, 2176  
 2177, 2178, 2179, 2180  
 2181, 2182, 2183, 2184  
 2185, 2186, 2187, 2188  
 2189, 2190, 2191, 2192  
 2193, 2194, 2195, 2196  
 2197, 2198, 2199, 2200  
 2201, 2202, 2203, 2204  
 2205, 2206, 2207, 2208  
 2209, 2210, 2211, 2212  
 2213, 2214, 2215, 2216  
 2217, 2218, 2219, 2220  
 2221, 2222, 2223, 2224  
 2225, 2226, 2227, 2228  
 2229, 2230, 2231, 2232  
 2233, 2234, 2235, 2236  
 2237, 2238, 2239, 2240  
 2241, 2242, 2243, 2244  
 2245, 2246, 2247, 2248  
 2249, 2250, 2251, 2252  
 2253, 2254, 2255, 2256  
 2257, 2258, 2259, 2260  
 2261, 2262, 2263, 2264  
 2265, 2266, 2267, 2268  
 2269, 2270, 2271, 2272  
 2273, 2274, 2275, 2276  
 2277, 2278, 2279, 2280  
 2281, 2282, 2283, 2284  
 2285, 2286, 2287, 2288  
 2289, 2290, 2291, 2292  
 2293, 2294, 2295, 2296  
 2297, 2298, 2299, 2300  
 2301, 2302, 2303, 2304  
 2305, 2306, 2307, 2308  
 2309, 2310, 2311, 2312  
 2313, 2314, 2315, 2316  
 2317, 2318, 2319, 2320  
 2321, 2322, 2323, 2324  
 2325, 2326, 2327, 2328  
 2329, 2330, 2331, 2332  
 2333, 2334, 2335, 2336  
 2337, 2338, 2339, 2340  
 2341, 2342, 2343, 2344  
 2345, 2346, 2347, 2348  
 2349, 2350, 2351, 2352  
 2353, 2354, 2355, 2356  
 2357, 2358, 2359, 2360  
 2361, 2362, 2363, 2364  
 2365, 2366, 2367, 2368  
 2369, 2370, 2371, 2372  
 2373, 2374, 2375, 2376  
 2377, 2378, 2379, 2380  
 2381, 2382, 2383, 2384  
 2385, 2386, 2387, 2388  
 2389, 2390, 2391, 2392  
 2393, 2394, 2395, 2396  
 2397, 2398, 2399, 2400  
 2401, 2402, 2403, 2404  
 2405, 2406, 2407, 2408  
 2409, 2410, 2411, 2412  
 2413, 2414, 2415, 2416  
 2417, 2418, 2419, 2420  
 2421, 2422, 2423, 2424  
 2425, 2426, 2427, 2428  
 2429, 2430, 2431, 2432  
 2433, 2434, 2435, 2436  
 2437, 2438, 2439, 2440  
 2441, 2442, 2443, 2444  
 2445, 2446, 2447, 2448  
 2449, 2450, 2451, 2452  
 2453, 2454, 2455, 2456  
 2457, 2458, 2459, 2460  
 2461, 2462, 2463, 2464  
 2465, 2466, 2467, 2468  
 2469, 2470, 2471, 2472  
 2473, 2474, 2475, 2476  
 2477, 2478, 2479, 2480  
 2481, 2482, 2483, 2484  
 2485, 2486, 2487, 2488  
 2489, 2490, 2491, 2492  
 2493, 2494, 2495, 2496  
 2497, 2498, 2499, 2500  
 2501, 2502, 2503, 2504  
 2505, 2506, 2507, 2508  
 2509, 2510, 2511, 2512  
 2513, 2514, 2515, 2516  
 2517, 2518, 2519, 2520  
 2521, 2522, 2523, 2524  
 2525, 2526, 2527, 2528  
 2529, 2530, 2531, 2532  
 2533, 2534, 2535, 2536  
 2537, 2538, 2539, 2540  
 2541, 2542, 2543, 2544  
 2545, 2546, 2547, 2548  
 2549, 2550, 2551, 2552  
 2553, 2554, 2555, 2556  
 2557, 2558, 2559, 2560  
 2561, 2562, 2563, 2564  
 2565, 2566, 2567, 2568  
 2569, 2570, 2571, 2572  
 2573, 2574, 2575, 2576  
 2577, 2578, 2579, 2580  
 2581, 2582, 2583, 2584  
 2585, 2586, 2587, 2588  
 2589, 2590, 2591, 2592  
 2593, 2594, 2595, 2596  
 2597, 2598, 2599, 2600  
 2601, 2602, 2603, 2604  
 2605, 2606, 2607, 2608  
 2609, 2610, 2611, 2612  
 2613, 2614, 2615, 2616  
 2617, 2618, 2619, 2620  
 2621, 2622, 2623, 2624  
 2625, 2626, 2627, 2628  
 2629, 2630, 2631, 2632  
 2633, 2634, 2635, 2636  
 2637, 2638, 2639, 2640  
 2641, 2642, 2643, 2644  
 2645, 2646, 2647, 2648  
 2649, 2650, 2651, 2652  
 2653, 2654, 2655, 2656  
 2657, 2658, 2659, 2660  
 2661, 2662, 2663, 2664  
 2665, 2666, 2667, 2668  
 2669, 2670, 2671, 2672  
 2673, 2674, 2675, 2676  
 2677, 2678, 2679, 2680  
 2681, 2682, 2683, 2684  
 2685, 2686, 2687, 2688  
 2689, 2690, 2691, 2692  
 2693, 2694, 2695, 2696  
 2697, 2698, 2699, 2700  
 2701, 2702, 2703, 2704  
 2705, 2706, 2707, 2708  
 2709, 2710, 2711, 2712  
 2713, 2714, 2715, 2716  
 2717, 2718, 2719, 2720  
 2721, 2722, 2723, 2724  
 2725, 2726, 2727, 2728  
 2729, 2730, 2731, 2732  
 2733, 2734, 2735, 2736  
 2737, 2738, 2739, 2740  
 2741, 2742, 2743, 2744  
 2745, 2746, 2747, 2748  
 2749, 2750, 2751, 2752  
 2753, 2754, 2755, 2756  
 2757, 2758, 2759, 2760  
 2761, 2762, 2763, 2764  
 2765, 2766, 2767, 2768  
 2769, 2770, 2771, 2772  
 2773, 2774, 2775, 2776  
 2777, 2778, 2779, 2780  
 2781, 2782, 2783, 2784  
 2785, 2786, 2787, 2788  
 2789, 2790, 2791, 2792  
 2793, 2794, 2795, 2796  
 2797, 2798, 2799, 2800  
 2801, 2802, 2803, 2804  
 2805, 2806, 2807, 2808  
 2809, 2810, 2811, 2812  
 2813, 2814, 2815, 2816  
 2817, 2818, 2819, 2820  
 2821, 2822, 2823, 2824  
 2825, 2826, 2827, 2828  
 2829, 2830, 2831, 2832  
 2833, 2834, 2835, 2836  
 2837, 2838, 2839, 2840  
 2841, 2842, 2843, 2844  
 2845, 2846, 2847, 2848  
 2849, 2850, 2851, 2852  
 2853, 2854, 2855, 2856  
 2857, 2858, 2859, 2860  
 2861, 2862, 2863, 2864  
 2865, 2866, 2867, 2868  
 2869, 2870, 2871, 2872  
 2873, 2874, 2875, 2876  
 2877, 2878, 2879, 2880  
 2881, 2882, 2883, 2884  
 2885, 2886, 2887, 2888  
 2889, 2890, 2891, 2892  
 2893, 2894, 2895, 2896  
 2897, 2898, 2899, 2900  
 2901, 2902, 2903, 2904  
 2905, 2906, 2907, 2908  
 2909, 2910, 2911, 2912  
 2913, 2914, 2915, 2916  
 2917, 2918, 2919, 2920  
 2921, 2922, 2923, 2924  
 2925, 2926, 2927, 2928  
 2929, 2930, 2931, 2932  
 2933, 2934, 2935, 2936  
 2937, 2938, 2939, 2940  
 2941, 2942, 2943, 2944  
 2945, 2946, 2947, 2948  
 2949, 2950, 2951, 2952  
 2953, 2954, 2955, 2956  
 2957, 2958, 2959, 2960  
 2961, 2962, 2963, 2964  
 2965, 2966, 2967, 2968  
 2969, 2970, 2971, 2972  
 2973, 2974, 2975, 2976  
 2977, 2978, 2979, 2980  
 2981, 2982, 2983, 2984  
 2985, 2986, 2987, 2988  
 2989, 2990, 2991, 2992  
 2993, 2994, 2995, 2996  
 2997, 2998, 2999, 3000  
 3001, 3002, 3003, 3004  
 3005, 3006, 3007, 3008  
 3009, 3010, 3011, 3012  
 3013, 3014, 3015, 3016  
 3017, 3018, 3019, 3020  
 3021, 3022, 3023, 3024  
 3025, 3026, 3027, 3028  
 3029, 3030, 3031, 3032  
 3033, 3034, 3035, 3036  
 3037, 3038, 3039, 3040  
 3041, 3042, 3043, 3044  
 3045, 3046, 3047, 3048  
 3049, 3050, 3051, 3052  
 3053, 3054, 3055, 3056  
 3057, 3058, 3059, 3060  
 3061, 3062, 3063, 3064  
 3065, 3066, 3067, 3068  
 3069, 3070, 3071, 3072  
 3073, 3074, 3075, 3076  
 3077, 3078, 3079, 3080  
 3081, 3082, 3083, 3084  
 3085, 3086, 3087, 3088  
 3089, 3090, 3091, 3092  
 3093, 3094, 3095, 3096  
 3097, 3098, 3099, 3100  
 3101, 3102, 3103, 3104  
 3105, 3106, 3107, 3108  
 3109, 3110, 3111, 3112  
 3113, 3114, 3115, 3116  
 3117, 3118, 3119, 3120  
 3121, 3122, 3123, 3124  
 3125, 3126, 3127, 3128  
 3129, 3130, 3131, 3132  
 3133, 3134, 3135, 3136  
 3137, 3138, 3139, 3140  
 3141, 3142, 3143, 3144  
 3145, 3146, 3147, 3148  
 3149, 3150, 3151, 3152  
 3153, 3154, 3155, 3156  
 3157, 3158, 3159, 3160  
 3161, 3162, 3163, 3164  
 3165, 3166, 3167, 3168  
 3169, 3170, 3171, 3172  
 3173, 3174, 3175, 3176  
 3177, 3178, 3179, 3180  
 3181, 3182, 3183, 3184  
 3185, 3186, 3187, 3188  
 3189, 3190, 3191, 3192  
 3193, 3194, 3195, 3196  
 3197, 3198, 3199, 3200  
 3201, 3202, 3203, 3204  
 3205, 3206, 3207, 3208  
 3209, 3210, 3211, 3212  
 3213, 3214, 3215, 3216  
 3217, 3218, 3219, 3220  
 3221, 3222, 3223, 3224  
 3225, 3226, 3227, 3228  
 3229, 3230, 3231, 3232  
 3233, 3234, 3235, 3236  
 3237, 3238, 3239, 3240  
 3241, 3242, 3243, 3244  
 3245, 3246, 3247, 3248  
 3249, 3250, 3251, 3252  
 3253, 3254, 3255, 3256  
 3257, 3258, 3259, 3260  
 3261, 3262, 3263, 3264  
 3265, 3266, 3267, 3268  
 3269, 3270, 3271, 3272  
 3273, 3274, 3275, 3276  
 3277, 3278, 3279, 3280  
 3281, 3282, 3283, 3284  
 3285, 3286, 3287, 3288  
 3289, 3290, 3291, 3292  
 3293, 3294, 3295, 3296  
 3297, 3298, 3299, 3300  
 3301, 3302, 3303, 3304  
 3305, 3306, 3307, 3308  
 3309, 3310, 3311, 3312  
 3313, 3314, 3315, 3316  
 3317, 3318, 3319, 3320  
 3321, 3322, 3323, 3324  
 3325, 3326, 3327, 3328  
 3329, 3330, 3331, 3332  
 3333, 3334, 3335, 3336  
 3337, 3338, 3339, 3340  
 3341, 3342, 3343, 3344  
 3345, 3346, 3347, 3348  
 3349, 3350, 3351, 3352  
 3353, 3354, 3355, 3356  
 3357, 3358, 3359, 3360  
 3361, 3362, 3363, 3364  
 3365, 3366, 3367, 3368  
 3369, 3370, 3371, 3372  
 3373, 3374, 3375, 3376  
 3377, 3378, 3379, 3380  
 3381, 3382, 3383, 3384  
 3385, 3386, 3387, 3388  
 3389, 3390, 3391, 3392  
 3393, 3394, 3395, 3396  
 3397, 3398, 3399, 3400  
 3401, 3402, 3403, 3404  
 3405, 3406, 3407, 3408  
 3409, 3410, 3411, 3412  
 3413, 3414, 3415, 3416  
 3417, 3418, 3419, 3420  
 3421, 3422, 3423, 3424  
 3425, 3426, 3427, 3428  
 3429, 3430, 3431, 3432  
 3433, 3434, 3435, 3436  
 3437, 3438, 3439, 3440  
 3441, 3442, 3443, 3444  
 3445, 3446, 3447, 3448  
 3449, 3450, 3451, 3452  
 3453, 3454, 3455, 3456  
 3457, 3458, 3459, 3460  
 3461, 3462, 3463, 3464  
 3465, 3466, 3467, 3468  
 3469, 3470, 3471, 3472  
 3473, 3474, 3475, 3476  
 3477, 3478, 3479, 3480  
 3481, 3482, 3483, 3484  
 3485, 3486, 3487, 3488  
 3489, 3490, 3491, 3492  
 3493, 3494, 3495, 3496  
 3497, 3498, 3499, 3500  
 3501, 3502, 3503, 3504  
 3505, 3506, 3507, 3508  
 3509, 3510, 3511, 3512  
 3513, 3514, 3515, 3516  
 3517, 3518, 3519, 3520  
 3521, 3522, 3523, 3524  
 3525, 3526, 3527, 3528  
 3529, 3530, 3531, 3532  
 3533, 3534, 3535, 3536  
 3537, 3538, 3539, 3540  
 3541, 3542, 3543, 3544  
 3545, 3546, 3547, 3548  
 3549, 3550, 3551, 3552  
 3553, 3554, 3555, 3556  
 3557, 3558, 3559, 3560  
 3561, 3562, 3563, 3564  
 3565, 3566, 3567, 3568  
 3569, 3570, 3571, 3572  
 3573, 3574, 3575, 3576  
 3577, 3578, 3579, 3580  
 3581, 3582, 3583, 3584  
 3585, 3586, 3587, 3588  
 3589, 3590, 3591, 3592  
 3593, 3594, 3595, 3596  
 3597, 3598, 3599, 3600  
 3601, 3602, 3603, 3604  
 3605, 3606, 3607, 3608  
 3609, 3610, 3611, 3612  
 3613, 3614, 3615, 3616  
 3617, 3618, 3619, 3620  
 3621, 3622, 3623, 3624  
 3625, 3626, 3627, 3628  
 3629, 3630, 3631, 3632  
 3633, 3634, 3635, 3636  
 3637, 3638, 3639, 3640  
 3641, 3642, 3643, 3644  
 3645, 3646, 3647, 3648  
 3649, 3650, 3651, 3652  
 3653, 3654, 3655, 3656  
 3657, 3658, 3659, 3660  
 3661, 3662, 3663, 3664  
 3665, 3666, 3667, 3668  
 3669, 3670, 3671, 3672  
 3673, 3674, 3675, 3676  
 3677, 3678, 3679, 3680  
 3681, 3682, 3683, 3684  
 3685, 3686, 3687, 3688  
 3689, 3690, 3691, 3692  
 3693, 3694, 3695, 3696  
 3697, 3698, 3699, 3700  
 3701, 3702, 3703, 3704  
 3705, 3706, 3707, 3708  
 3709, 3710,

handed writing have in common a similar pictorial effect, slant, and many letter forms. The lower loops of the letters "y", "g" and "J", however, are closed to the left of the staff, a characteristic similar to that found in the normal left-handed writing. A detailed study of this handwriting and the normal left and right hand writing of this person discloses a very interesting inter-mixing of right and left hand characteristics.

The experience of this person adds credence to the theory that a left handed individual might encounter speech difficulties if forced to write with the right hand. This person, when required to write exclusively with the right hand while attending school, developed a stammer and, even today, experiences some speech difficulty under stress.

### Discussion of Mr. Zitzelsberger's paper

M McNALLY: I understand from the administrative assistant in New York City Public Schools system that they are changing all children from left to right.

SMITH: The reasons why the left handed writer hooks his hand even more than we saw in the illustration is, first, he wants to see the point of his pen as it is being applied to the paper, and secondly, if he uses the fluid ink he is liable to smudge his writing. In one case we had involving ambidextrous writing, there was very little perceptible difference in the left and right handed writing and this paper points out the fact that we are frequently asked to say whether this is a left or right handed writer. I am afraid that I have had to say in most cases that I was not able to do so, but what is primarily important to us as document examiners is to point out the necessity that in your specimen handwriting you should always have specimens from both hands.

SOMERFORD: There is a system of handwriting that was developed by someone in the State of Michigan especially for left handed writers.

HEAD: In Regina they are not trying to change a child's handwriting but it would appear to me that they are more or less the forgotten pupil, they must get along as best as they can trying to make the letter forms. There is no suggestion how they should hold the pen and do a better job of writing.

GODOWN: With respect first to this writing of this woman who is ambidextrous and does mirror writing. I wonder if you could draw any valid conclusions from her left handed writing because it may be a mixture of mirror writing with left handed writing. I ran across a book on the subject of ambidexterity and left handed writing, a man by the name of Jackson who is a British writer responsible for the vertical writing that came in in the 1890's. I have had a few opportunities to observe the writing of individuals who were ambidextrous and to get specimens and to compare them one with another and it struck me that the differences that were found were primarily with respect to the physical execution of writing by either the left or right hand whereas the mental concept of the letters and their structure was fundamentally similar between the two writings.

BOONE: I have had an opportunity to examine the ambidextrous writing of one civilian employee and one member of our department and in these two instances found a remarkable resemblance in the writing except for the slope.

WRENSHALL: The tendency is to make a fairly large initial loop at the beginning of initial strokes. I have noticed it upon occasion in my own and one or two other persons' writing who use this backwards upside down position.

PURTELL: Two years ago, the Handwriting Foundation met in Chicago and the man that received the reward for doing the most work during the year for



the advancement of handwriting had written a thesis for his doctor's degree on left handed writing I think he claimed that 11 or 13 per cent of the population write with their left hand and he also states that one of the difficulties in writing with your left hand is that in most of the letters you are pushing the pen against the paper and that will cause the quality of the writing to deteriorate.

SMITH: The paper suggests the left handed writer could only be determined by shading and pressure and that the other features that we would normally look for did not disclose the fact that this was a left handed writer. I think it is a very important point and how much reliability may be placed on pressure and shading is probably a moot question. It was stated that in the left handed writing the strokes of the "t" were from right to left that is also another hazardous assumption. In my experience I find that that is a variable tendency that either a right or a left handed person may practice.

WRENSHALL: Due to this question of pushing the pen against the paper, you will quite often find, and I think I observed in the writing shown as the position "A", that the pen pressure tends to be very light and sometimes almost non-existent to get away from this danger of digging the pen point into the paper. It is not so observable in ball point pen writing.

# The Potentialities of the Blink Microscope Principle in Typewriting Comparisons

R. A. HUBER

R.C.M.P. Crime Detection Laboratories

Ottawa.

## Introduction

The comparison of typewriting as presently conducted by Document Examiners is largely dependent for its success upon three basic factors:

- (a) The examiner's individual ability to recognize or distinguish between delicate differences in form,
- (b) The nature of the equipment used and its capacity to measure, magnify and/or juxtapose the two characters under examination,
- (c) and, (if inspection of each character must be made through separate oculars), the examiner's ability to carry a mental image of one type design while viewing the other.

Examination is greatly facilitated if a form of low power comparison microscope is used which has a split field allowing juxtapositioning of the characters. Synchrisscopes, therefore, have been frequently used for this purpose.

Even the split field of the synchriscope or comparison microscope wherein the images of the two characters are ideally situated side by side still requires the examiner to render the final judgment of minute differences in linear dimensions, angles and degrees of curvature.

It was considered that some investigation should be made of the application of blink principle as generally used by astronomers in the inspection of photographs taken at periodic intervals to detect changes in position of the planets and other heavenly bodies. In viewing alternately two photos of the same field of view a very slight alternation in position of one of the objects so recorded will produce a noticeable oscillation. Pulfrich<sup>1</sup> adapted the principle to the microscope through the use of a set of combined prisms which received images from opposite directions and projected both complete fields through a single ocular. This process results in superimposition of the two fields. By means of a set of shutters either field could be viewed independently and both fields alternately.

## Theory

Two identically designed typewritten characters when their images are precisely superimposed viewed alternately, produce no illusion of motion or oscillation of any of their parts.

Two differently designed yet greatly similar typewritten characters when corresponding portions of their images are precisely superimposed under these conditions should, when their images are viewed alternately, produce an illusion of motion or oscillation and the magnitude of the oscillation will be in proportion as the degree of difference.

<sup>(1)</sup> C. Pulfrich, *Ueber ein neues Spiegelstereoscope*, Zeitschrift für Instrumenten Kunde (1912)

## **Experimentation**

For the purposes of this study the central prism was removed from a stirling synchriscope (manufactured by Negretti & Zamba, London) and replaced with another patterned after that of Pulfrich's prisms which permitted superior positioning of two fields as viewed through a monocular lense system. The prism was designed and prepared especially for the R.C.M.P. by the Division of Applied Physics of the National Research Council.

Various methods were considered for alternating the fields of view and so providing the blink principle. The method adopted for the prototype was one involving two 10" discs punched with a series of holes whose diameters equal the minimum distance between them. Synchronization of the discs was maintained by a chain union. They were driven by belt and pulley from a small sewing machine motor whose speed was controlled by rheostat. The discs were suspended in front of the synchriscope so that the objectives of the instrument were positioned directly over the center of a hole in one of the discs and a space between holes in the other disc, respectively.

Both stages of the scope were constantly illuminated and viewed alternately through the holes of the rotating discs which were now so positioned that while view of one field was permitted through a hole of one disc the view through the other objective was interrupted by the body of the second disc.

Provision must, of course, be made for the temporary viewing of both fields simultaneously in order to align the superimposed images in the initial step of the examination. This was accomplished in the prototype by means of a pin lock through the chain gear of one disc, which when removed allowed free manual rotation of that disc and when reinserted fell into position only at points at which the two discs were properly synchronized.

The typewritten characters to be compared were positioned beneath the objectives so that their images were perfectly super-imposed insofar as two or more corresponding elements or sections of the characters. Generally the serifs and stems of the letters served orientation purposes best. To be certain of superimposition the blink principle was applied with the hands until no motion or oscillation was noted in the portions selected for orientation except where difference in the density of the impressions produced an expansion and contraction of the points or lines.

## **Results**

While studies to date are admittedly not extensive, there is considerable evidence that the blink microscope principle can be usefully and successfully applied to typewriting comparisons. The oscillation theoretically expected with type designs which do not precisely correspond does in fact occur. Differences of the order of 0.004 inches or less were distinguished. Indeed, so sensitive is the principle that in some cases it is extremely difficult to eliminate oscillation in identical type characters. While some skill in interpreting results must be acquired through practice the element of human error in judgment by this method is reduced.

Comparisons are more satisfactorily conducted if the fields are alternating at relatively slow rates. These studies found 0.5 to 0.25 second intervals suitable.

Most essential in the use of this instrument is precision controlled stages capable of fine adjustment on the horizontal plane (preferable to .001 inches) in two linear directions as well as rotational. A vertical adjustment would assist in accommodating exhibit material of greater than single document

thickness. With the present prototype considerable difficulty was encountered in precisely superimposing the images without the aid of adequate stages.

Front lighting or back lighting is preferable to side lighting. Fluorescent lighting has some advantage over tungsten lighting. The lighting for each stage should be independently variably controlled.

In application it was found that this instrument provides little improvement over present methods of measurement (by means of precision ruled glass measuring plates) of lineal dimensions or distances or of simple circular radius curves. This instrument's greatest benefit is derived in the comparison of compound curves, continuously changing curves, positions of intersection, lengths of cusps and other more complex portions of the type face design. It is particularly useful in the comparison of the lower case letters a, c, e, f, g, k, r, s, y and other oval or bowl-type letters such as the cap O, cap Q, small i, d, p, and q. Even greater assistance is rendered in the study of the figures 2, 3, 5, 6, 7, and 9 as well as many of the standard symbols.

Considerable assistance might also be derived in the classification of typeface according to the Hilton System, eliminating some of the errors possible in borderline cases.

In the annual inspection of a manufacturer's typeface and the comparison with samples of the previous year's production for the detection of minor modifications, the blink microscope permits a more detailed study to be made of a greater number if not all the keyboard characters.

Identification or differentiation of typewriting should be possible with this instrument in a greater number of cases where the amount of questioned typewriting is limited, through its ability to make more detailed comparisons of some letters and symbols not heretofore possible.

As manufacturers tend to adopt common type designs which have reached the apparent optimum in taste and function and the general consequence is for their products to become more and more alike, this instrument may provide even greater service in enabling the examiner to make finer distinctions with greater accuracy between such type designs.

## Summary

The blink microscope principle was applied to the comparison of typewritten impressions with reasonable success, though it is doubtful if it will ever entirely replace the conventional methods of comparison and measurement.

It is important to have delicately controlled stage facilities for the movement of the characters under examination and such should be perfected before further studies of the principle are conducted. The illusion of motion from oscillation which this instrument is capable of producing can be considered a reliable indication of discreet differences only when identical images are consistently and readily shown to be without this effect.

The application of such an instrument reduces to some extent the possibility of human error and its use will vary directly as the tendency of manufacturers to produce less distinctive and more similar type designs.

## Discussion of Mr. Huber's paper

SOMERFORD: This instrument certainly offers a lot of potentialities for the examination of the minute differences that exist between typewritten impressions. It is an instrument along the lines of this system, that was developed by the Library of Congress to check letter-size documents, to see whether or not



manuscripts were identical or not through a blink system of this type, however, this instrument is the size of an upright piano, and costs about \$2,000. to \$2,500.

HUBER: Yes, it was apparently designed to take a whole book and facilitate examination of single pages at a time, and, rather than going through the tedious examination of word by word, line by line, they merely set up the two respective pages, and by the blink principle, any difference in the type or type setting of the two pages would be noticeable through the oscillations.

SOMERFORD: The motor arrangement is an improvement over the other one.

HUBER: I think you should have a controlled alternating system, but I would do it in a little different fashion, if I were doing it again. I would cut the discs into quarters and extract a whole quarter, having two opposed quarters sections. Then one might be able to rotate the discs at a faster rate and obtain a more rapid cut from one field of view to the other. Linton Godown has done additional work on this, probably for a great deal longer than we have been working on it and he has similar ideas using a little different type of prism system in which you accomplish the same thing by an oscillation of the head. It seems to work quite satisfactorily and certainly with a simpler construction.

BOONE: It occurs to me that the time necessary to get the material aligned might be considerable, since it must be done accurately before you start blinking.

HUBER: The time element is a factor and this is why we must have staging first. With proper staging you can avoid a lot of wasted time. I think that this will have its particular advantage when you are restricted in questioned material, to a matter of a dozen or two letters, the address on an envelope or something of that nature, where you are not going to have a great combination of accidental characteristics to consider. This gives you an opportunity to consider a number of factors which you cannot otherwise take into account with visual inspection alone.

GODOWN: Have you given any attention, to the matter of applying this, not to comparison of design characteristics but to the comparison of what would be individual typewriter defects such as the off the feet condition found in two writings or the exact location of a defect in say the letter "o" or the position on the curve where it occurs and close observation of the nature of the defect.

HUBER: Yes, I have and in the case of damaged or shortened serifs, I found that if you have in one instance a serif which is damaged to a greater degree in that it is shortened to a greater extent, you get oscillation. Of course, if there is a bend with the damage it also gives you motion in another direction. The problem is that typewritten impressions, even two typewritings on the same machine made one after the other, are not too constant. Where you have a difference in density of the impressions you get a natural expansion and contraction but if your two characters are exactly the same, it should be uniform and merely give you an expansion in contraction in two dimensions, thinning and widening of the line. There should be no change in the design, in the degree of curvature at any point or in the location of a connection point. But you do have differences in the weight of impressions and when you are checking minute damages to the type bar itself, one must be sure that there is a true difference in the degree of damage rather than just a difference in the density of the impression. This only works in one direction. If your heavier

impression has a shorter serif it is definitely a difference in the degree of damage because your densest impression, all other things being equal, should have if anything the longer serif.

Godown: A great many people suffer from a condition that is known as form blindness or at least an inability to critically compare forms. It occurred to me that while you cannot go into Court with any ease or economics and present a motion before a jury, if you were to take the polaroid vectograph process which was used for three dimensional prints and transparencies, during the war, and if you were instead of using it as a stereoscopic material were to superimpose your images, the one on the face being polarized one way and the one on the back being polarized the other way, and then project a rotating beam of polarized light, presented on a nice large transparency scale, a jury could not fail to see the difference in design, if you had a difference problem.

# Proportional Spacing Typewriter Identification

LINTON GODOWN

Chicago, Ill., and Memphis, Tenn.

The proportional spacing typewriter differs fundamentally from conventional typewriters in that the lateral space accorded each letter or character is not uniform. The spacing is in keeping with the relative widths of accepted letter designs used by printing trades. This is accomplished by automatic selection of an appropriate number of spacing units as each key is struck or depressed. While such typewriters existed in the late '30's relatively few found their way into users' hands before 1947. In the decade since their practical introduction by IBM they have found a growing acceptance, particularly for executive and law office use and for the preparation of copy for photo-mechanical processes.

If the past history of office machines is any criterion, we should look for a marked increase in the use of proportional spacing typewriters in the next few years. While IBM was originally alone in offering this kind of typewriter for office use, they are now joined by Remington-Rand with a similar electric machine and Olivetti with a manually operated version. The experimental Underwood differential spacing or "dual-pitch" machines it appears have been withdrawn from the market. It is no secret that most domestic manufacturers have proportional spacing models in various stages of development.

During the latter part of 1956 considerable attention was devoted to the various IBM proportional type fonts and their history, which culminated in a paper given by Ordway Hilton before the Document Section of the AAFS meeting at Chicago, March 1, 1957. This excellent paper, with its numerous half-tone illustrations, has recently been printed in Vol. 3, No. 2, *Journal of Forensic Sciences*, pp. 263-287, July 1958. The material in this study is intended to augment and supplement the Hilton paper by supplying some omissions and developments since its date.

Typewriting design information and charts should always be received and used with caution. There is reason to believe that not everyone appreciates the limitations of published typewriting identification materials. Such sources of information regarding type designs dates and changes may be very useful in leading the document examiner to a point of entry into his specimen files. Except in most unusual circumstances, published material should never be relied on in actual case work. Identifications not founded on reference to and inspection of actual machine specimens of the types involved are ill advised and may readily lead to serious professional embarrassment.

## ***Other Proportional Type Designs***

For some years a number of IBM typewriters, both conventional and proportional, have found use as a part of other writing devices. Commercial Controls Corp., Rochester, N.Y. (now a part of Friden Calculators) is one user whose product might be encountered in document work. They make typewriting devices controlled by punched tape and marketed under the trade names of *Justewriter* and *Flexowriter*. These are expensive automatic machines for justified printing composition and specialized repetitive typing. They are unlikely to be encountered other than in large commercial or printing concerns.

It should be noted that while standard IBM fonts are supplied on many of these machines, Commercial Controls offer a number of exclusive designs that differ from IBM designs. Their use of IBM designs may be with different character and unit widths and line spacing.

The *Justowriter* is a "cold-type" composing machine used to prepare direct or photo copy for lithographic printing processes. *Flexowriters* are essentially automatic punched tape controlled typewriters intended for advertising and forms writing use. Both classes make use of five channel punched tape. Several models of varying specifications are available. Those used to prepare punched tapes are called "recorders" while those using tapes to automatically type out text or copy are termed "reproducers". Some models perform both functions. One feature of the *Justowriter* is the preparation of proof "copy" while punching tape and automatically calculating space adjustments that will be required to turn out justified printing copy from the tape prepared. Both fabric and carbon ribbons are used.

Commercial Controls supplies machines equipped with the following:

*I.B.M. Types:*

- 1/32" units — Secretarial (26)
  - Bold Face #1 (16) as Boldface 66, 62, 55, 50, and 44 tooth ratchet.
  - Modern (32) 66, 62, 55, 50, 44 tooth ratchet.
  - Documentary (40) 66, 62, 55, 50, 44 tooth ratchet.
  - Bold Face Italics (59)
  - Directory (66)
  - Testimonial (71) as *Galvin* 66, 62, 60, 55, 50, 44 tooth ratchet.

1

qwertyuiopasdfghjklzxcvbnm  
 QWERTYUIOPASDFGHJKLZXCVBNM  
 2345678901";',.- Justowriter  
 &/\$%±]\*()½#:‘!?’+  
 10C17I58 Commercial ← ← ←

qwertyuiopasdfghjklzxcvbnm  
 QWERTYUIOPASDFGHJKLZXCVBNM  
 2345678901¼;’,.- Justowriter  
 &/\$%?!\*()½¼:‘,— Rogers ← ← ←  
 Chicago October 1, 1958

1/32" Unit Spacing

Figure 1



1/36" units — Mid-Century (50)  
 Bold Face #2 (57) as *Booktype*  
 Heritage (61)  
 Registry (65)

1/45" units — Text (47) with 1/48" unit spacing.

It seems likely that the other IBM types would be available on order.

In addition to the foregoing IBM types, Commercial Controls employs the following

*Exclusive Designs:*

1/32" units, 14 pt. *Commercial* — a large sans-serif, uniform weight Gothic design.

12 pt. *Rogers* — 60, 55, 50, 44 tooth ratchet (66 or 62 not recommended). An adaptation of Bruce Rogers' Centaur printers' type to proportional spacing typewriter limitations. (Fig. 1).

1/48" units, 8 pt. *Galvin* — similar to but not exactly a reduced size version of their 12 pt. Galvin.

8 pt. *Newstype* — A condensed type with abbreviated ascenders and descenders. (Fig. 2).

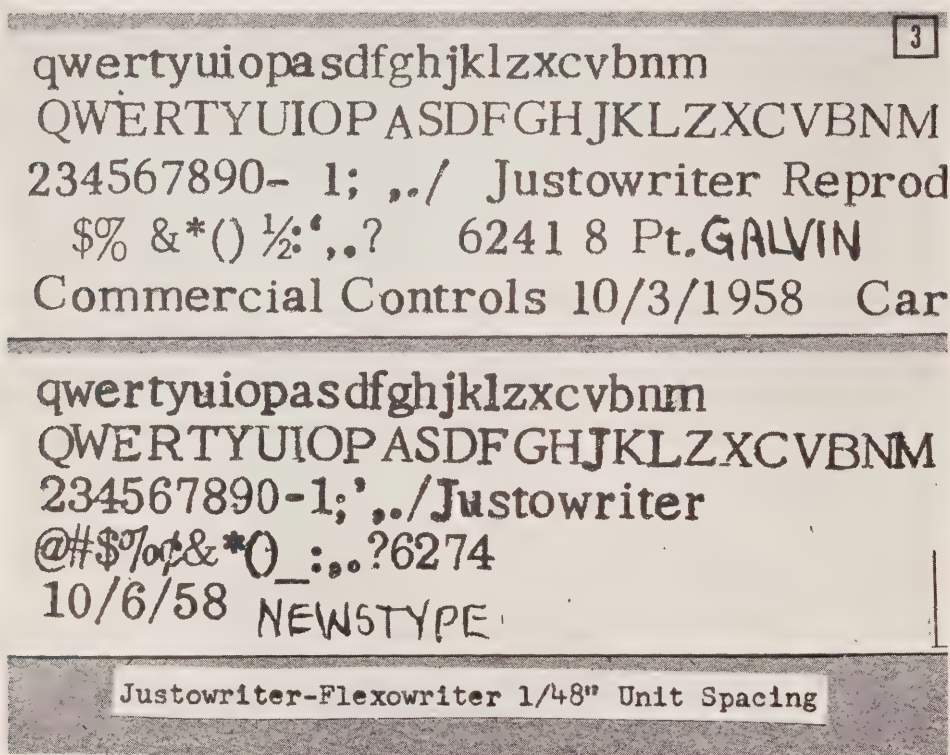


Figure 2

# LINE SPACINGS NORMALLY SUPPLIED

| Number of teeth |          | Number of Lines per Inch |          |  |
|-----------------|----------|--------------------------|----------|--|
| in rachet :     | Single : | Double :                 | Triple : |  |
| 66              | 6        | 4                        | 3        |  |
| 62              | 5.64     | —                        | —        |  |
| 60              | 5.46     | 3.63                     | 2.72     |  |
| 55              | 5.0      | —                        | —        |  |
| 50              | 4.56     | 3.34                     | 2.5      |  |
| 44              | 4        | —                        | —        |  |

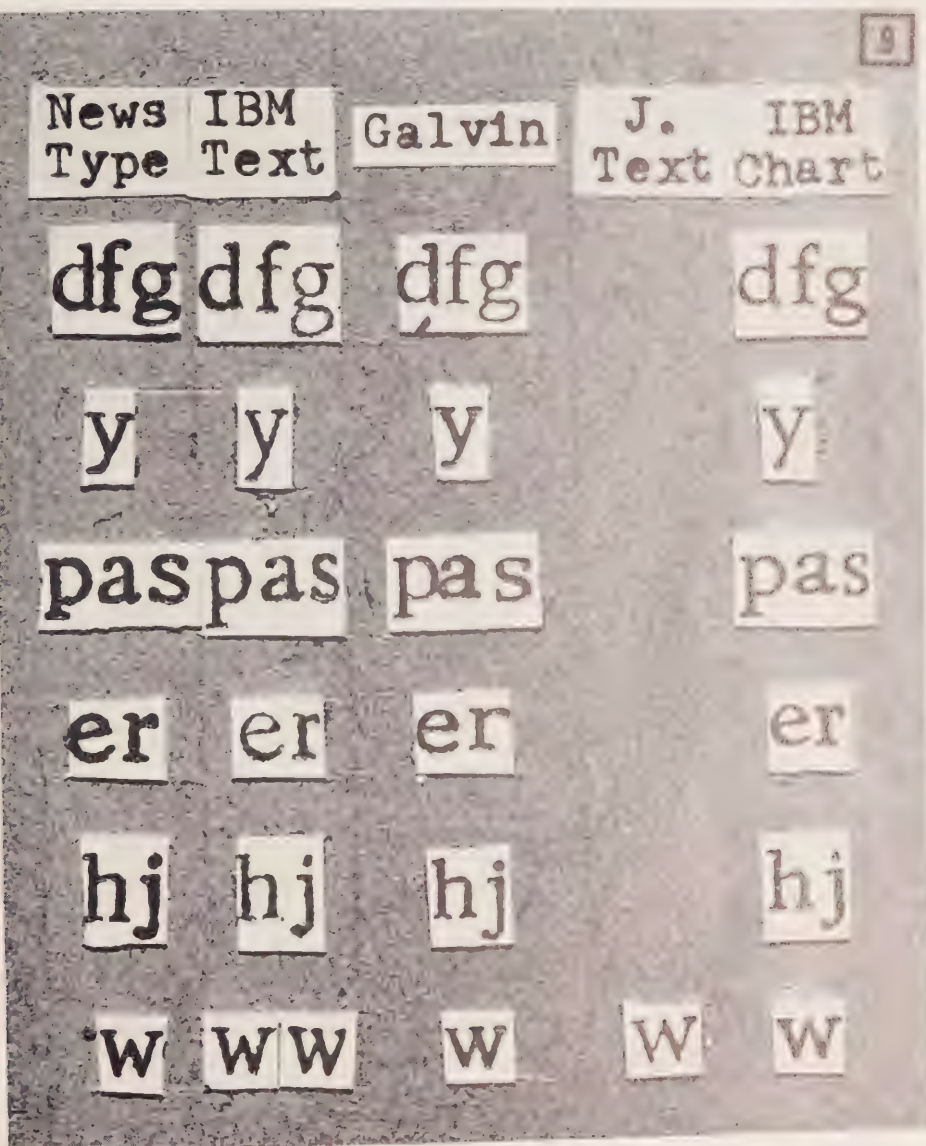


Figure 3

With the appearance of the *Justewriter* and *Flexowriter* machines in 1951, 12 point *Galvin* and 12 point *Rogers* were available. Factory correspondence indicates both styles were in the design stage in the late 40's. Close comparison of *Galvin* with IBM's *Testimonial* shows them to be the same design. This is substantiated by information that IBM acquired the *Galvin* design from Commercial Controls in 1953 and released it under the name *Testimonial*. *Testimonial* impressions dated between 1951 and 1953 are probably from

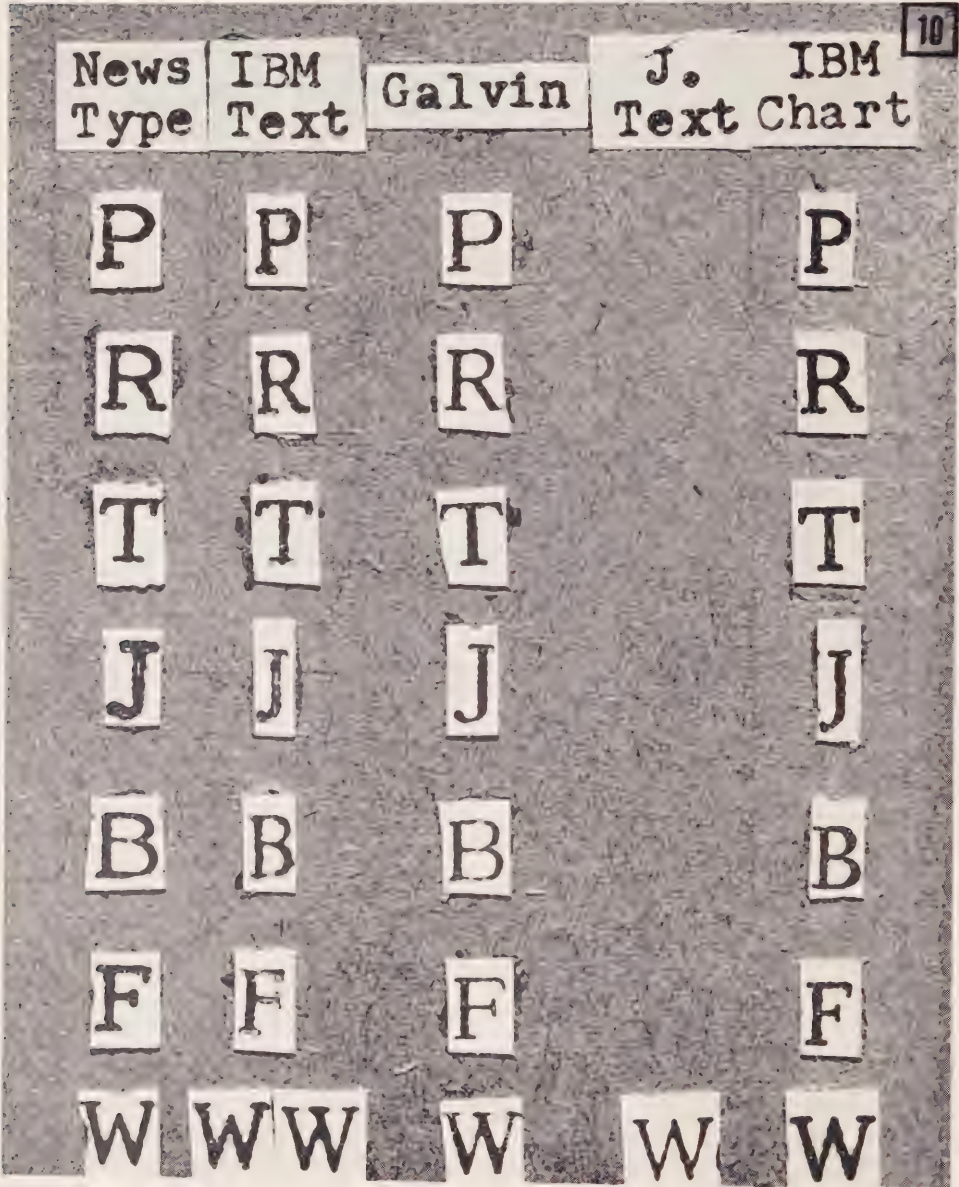


Figure 4



HAHBHCHDHEHFHGH HHHI HJH  
 HKHLHMHNHOHPHQHRHSH  
 HTHUHVHWHXHYHZHhahbhch  
 hdhehfghghhhijhkhlmhnhohph  
 hqhrhshstuhvwhxhyhzh1h2h3h  
 h4h5h6h7h8h9h0h¼h½h.h.h:h:h  
 h'h'h!h?h-h\_h/h=h+h(h)h#h\*h  
 h&h@h¶h§hçh\$h%h

No. 661 Monticello 1/32" unit.

HAHBHCHDHEHFHGH HHHI HJH  
 HKHLHMHNHOHPHQHRHSH  
 HTHUHVHWHXHYHZHhahbh  
 hchdhehfghghhhijhkhlmhnhoh  
 hphqhrhshstuhvwhxhyhzh1h2h  
 h3h4h5h6h7h8h9h0h¼h½h.h.h:h:h  
 h;h'h'h!h?h-h\_h/h=h+h(h)h#h  
 h\*h&h@h¶h§hçh\$h%h

No. 663 Imperial 1/32" unit.

HAHBHCHDHEHFHGH HHHI HJHKLHMHNNH  
 HOHPHQHRHSHTHUHVHWHXHYHZHhah  
 hbchdhehfghghhhijhkhlmhnhohphqhrhsh  
 hthuhvwhxhyhzh1h2h3h4h5h6h7h8h9h0h¼h  
 h½h.h.h:h:h'h'h!h?h-h\_h/h=h+h(h)h#h\*h&  
 h@h¶h§hçh\$h%h

h1h2h3h4h5h6h7h8h9h0h.h-hihñhñ'h  
 h.h³h⁹h\_jçh

No. 662 Bell Gothic 1/45" unit.

HAHBHCHDHEHFHGH HHHI HJHKLH  
 HLHMHNHOHPHQHRHSHTHUHVH  
 HWHXHYHZHhahbhchdhehfghghh  
 hihjhkhlmhnhohphqhrhshstuhvwh  
 hxhyhzh1h2h3h4h5h6h7h8h9h0h¼h  
 h½h.h.h:h:h'h'h!h?h-h\_h/h=h+h  
 h(h)h#h\*h&h@h¶h§hçh\$h%h



No. 664 Viceroy 1/36" unit.

Figure 5

HAHBHCHDHEHFHGH HHHI HJH  
 HKHLHMHNHOHPHQHRHSH  
 HTHUHVHWHXHYHZHhahbhch  
 hdhehfghghhhijhkhlmhnhohph  
 hqhrhshstuhvwhxhyhzh1h2h3h  
 h4h5h6h7h8h9h0h¼h½h.h.h:h:h  
 h'h'h!h?h-h\_h/h=h+h(h)h#h\*h  
 h&h@h¶h§hçh\$h%h

No. 665 Envoy 1/32" unit.

HAHBHCHDHEHFHGH HHHI HJHKLH  
 HMHNHOHPHQHRHSHTHUHVHWH  
 HXHYHZHhahbhchdhehfghghhhijh  
 hkhlmhnhohphqhrhshstuhvwhxhyh  
 hzh1h2h3h4h5h6h7h8h9h0h¼h½h.h  
 h.h:h:h'h'h!h²h-h\_h/h=h+h(h)h#h\*h  
 h&h@h¶h§hçh\$h%h

No 667 Regent 1/36" unit.

HAHBHCHDHEHFHGH HHHI HJH  
 HKHLHMHNHOHPHQHRHSHTH  
 HUHVHWHXHYHZHhahbhchdh  
 hehfghghhhijhkhlmhnhohphqh  
 hrhshstuhvwhxhyhzh1h2h3h4h  
 h5h6h7h8h9h0h¼h½h.h.h:h:h'h  
 h'h!h?h-h\_h/h=h+h(h)h#h\*h&h  
 h@h¶h§hçh\$h%h not available  
 S-58

No. 666 Chancellor 1/32" unit.

HAHBHCHDHEHFHGH HHHI HJH  
 HKHLHMHNHOHPHQHRHSHTH  
 HUHVHWHXHYHZHhahbhchdheh  
 hfghghhhijhkhlmhnhohphqhrhsh  
 hthuhvwhxhyhzh1h2h3h4h5h6h  
 h7h8h9h0h¼h½h.h.h.h:h:h'h  
 h-h\_h/h=h+h(h)h#h\*h&h@h¶h§h  
 hçh\$h%h not available S-58

No. 668 Emissary 1/32" unit.

-44-

Figure 6



Commercial Controls equipment. See chart comparing Testimonial and 12 point Galvin types. Attention is directed to the "r", "s" and punctuation spacing.

Commercial Controls supplies small types for composition intended to be used actual size. For such applications they have two exclusive designs, 8 point *Galvin* and 8 point *Newstype*, as well as a version of IBM's *Text*. All are supplied with 1/48" unit spacing as contrasted with IBM 1/45" unit spacing. A series of charts permits close comparison and differentiation of these small type designs including IBM's *Charter*. The letters "y", "g", "r", "a" and "w" are helpful as well as the ascending and descending letters. Of the capitals, "R", "T", "Q", "J" and "B" are most useful. (Fig. 3 & 4).

In about March of 1958 Olivetti began to offer a manually operated proportional spacing typewriter in the U.S.A., their "*Graphika*" model. It is said to have been available in Europe since sometime in 1956. Two type fonts are available; *Reiner* and *Cassandra*.

Only the latter is exported to the U.S. Both designs are highly distinctive and not readily confused with other proportional type designs. Unit spacing approximates 1/32" but actually is about 0.8 mm.

In the late fall of 1957 *Remington-Rand* announced their "*Statesman*" model. This is an electric proportional spacing typewriter similar in many respects to the IBM product. Demonstration machines were available in larger branches before the end of 1957 but deliveries to customers on orders were scheduled for early 1958. Originally four of six announced type styles were available: *Monticello*, #661, 1/32" unit; *Imperial*, #663, 1/32" unit; *Viceroy*, #664, 1/36" unit, and *Regent*, #667, 1/36" unit. In the summer of 1958 the remaining two of the six originally announced styles were made available; *Bell Gothic*, #662, 1/45" unit, and *Envoy*, #665, 1/32" unit. As this is written, ribbon specimens of these styles are unavailable for study. However, an alignment sheet consisting of reproductions of eight type styles has been inspected and photographed. (Fig. 5 & 6). This reproduction includes two 1/32" unit styles as yet unannounced — *Chancellor*, #666, and *Emissary*, #668. All eight Remington styles can be distinguished from IBM type. Only three of the eight styles closely resemble IBM types and require detailed comparison. The stock numbers assigned strongly suggest that all eight styles have been in existence since 1957 whether offered to the public or not. A machine equipped with #662 *Bell Gothic* passed through the Chicago service department in December 1957 before any machines were being received for delivery on orders.

#### *IBM — Remington Type Comparisons: General Considerations.*

Remington presently makes use of two units of space for the period and comma whereas IBM employs three units for each. Similar spacing was originally used by IBM but abandoned some years ago because of spacing conflicts in columns of numerals where the three unit space is standard. The presence or absence of two unit spacing for . , alone is unreliable as this can be readily changed by locally made mechanical adjustment. A general distinguishing feature between IBM and Remington concerns the location of the underscore with respect to the base line. As many documents contain this character employed to form a signature line, this may provide a quick differentiation feature. Other differences observed relate to particular type fonts.

#### *IBM Modern (#32) — Remington Monticello (#661) 1/32" units: (Fig. 7).*

Detailed comparison of these two similar styles reveals a number of differences some of which, although subtle, are fundamental design differences. For example, ball-like endings of the "y", "j", "J" and "f" of Remington contrast with the design of these letter parts by IBM. Similarly the upper serifs have been given a somewhat more square treatment by Remington as compared

qwertyuiopasdfghjklzxcvbnm  
QWERTYUIOPASDFGHJKLZXCVBNM  
234567890-1;','./IBMExecutive  
!@#\$\$%&\*()\_!:" ,. ? 139,543  
11M6T56 Almost New *May or June*

qwertyuiopasdfghjklzxcvbnm  
QWERTYUIOPASDFGHJKLZXCVBNM  
1234567890-=1/2;','./RemPropElect  
!@#\$\$%&\*()\_+1/4:" ,.? ES2251679  
10M25T57 New ~~Modern~~ *Monticello*

qwertyuiopasdfghjklzxcvbnm  
QWERTYUIOPASDFGHJKLZXCVBNM  
234567890-1;','./IBMBoldFace#1  
!@#\$\$%&\*()\_!:" ,. ? 145573  
IBMBoldFace#1Executive 9N27Y56

qwertyuiopasdfghjklzxcvbnm  
QWERTYUIOPASDFGHJKLZXCVBNM  
1234567890-=1/2;','./RemStatesman6643  
!@#\$\$%&\*()\_+1/4:" ,.? ES2251694  
RemingtonStatesmanImperial663 2N10Y58

qwertyuiopasdfghjklzxcvbnm  
QWERTYUIOPASDFGHJKLZXCVBNM  
234567890-1;','./IBMExecutive  
!@#\$\$%&\*()\_!:" ,. ? 37112  
9M27T54 Used Mid-Century

qwertyuiopasdfghjklzxcvbnm  
QWERTYUIOPASDFGHJKLZXCVBNM  
1234567980-=1/2;','./RemStatesman664  
!@#\$\$%&\*()\_+1/4:" ,.? ES2246236  
RemingtonStatesmanViceroy664 2N10Y58

Figure 7

with the angle given these serifs by IBM. See "i, p, d, h, k, j, l and b". The most distinctive differentiating characteristics are found in the longtailed "6 and 9" of IBM which extend above and below other numerals. Also useful are the swash stroke of the "R", the width of the "A", the enclosed area of the "P" and the double serifs of the "p, l and l (one)". CAUTION: The obviously different "e" and "a" are not reliable when considered alone. IBM used an "e" similar to the present Remington at one time. The "a" hook where present would indicate IBM — absent it indicates nothing. (Serif differences, unless present in combination, may be misleading.)

*Boldface #1 (16) — Imperial (#663) 1/32" units: (Fig. 7).*

Enlargements of these two similar styles show them to be generally similar. The most useful design differences seem to be the double serif of the "p", "i" and "r", the different size and shape bowl of the "P", the width of the "U" and the outstanding difference in the comma designs — Remington having no distinct curved "tail". This latter difference should be used with caution, due to possible alternate designs.

*Mid-Century (#50) — Viceroy (#664): (Fig. 7).*

This design may give difficulty when encountered. The width of the Remington "v" and "V" is greater and the "1" (one) slightly longer. The enclosed areas of the "B, P and &" may offer some help and the interior joining of the upper and lower lobes of the "3" may be distinctive.

*Vari-Typer "DSJ" Typewriters:*

At the time of the Chicago newspaper compositors' strike in 1947 the Coxhead Corporation began supplying a proportional spacing model of their Vari-Typer composition machine. This is called the "DSJ" model. Coxhead is now part of the Addressograph-Multigraph Corp. Although these are relatively expensive machines intended for highly specialized work, they are used to write on paper and conceivably could figure in a document investigation. A brief consideration will be given identification of their output.

The Vari-Typer is a type segment writing machine which was developed from the early Hammond typewriter. Type fonts take the form of metal semi-circular segments on which the characters are arranged in three rows. Depressing a key, positions the segment both laterally and vertically with respect to the printing position and the impression is made by a hammer forcing the paper background against the exposed type with a ribbon intervening. The striking force comes from a hammer operating in the position occupied by the platen in conventional typewriters. The Vari-Typer has no roller platen. Two segments (type fonts) are normally available in the machine and these may be readily replaced by other segments with a little effort. Between 200 and 300 type sizes and styles are available, over 100 of which are widely used. The machines permit use of a variety of horizontal and vertical spacings. The work of Vari-Typer DSJ machines can be distinguished from that of other more conventional proportional spacing typewriters without difficulty if it is kept in mind that the machines are primarily "cold type" composition machines for use in the printing trades. From the viewpoint of the document examiner, this is apparent from the type designs and the spacing of impressions.

All Vari-Typer type designs are intended to be close matches to those of metal printing type. The widths of various letters follow the long established practices of printing type designers and founders. (A suggested quick preliminary test involves the "m" which is four units wide "narrower than the 'M'" on the Vari-Typer and five units "the same width as the 'M'" on the more common proportional spacing typewriters, IBM and Remington). The unit spacing of the Vari-Typer is based on printers measures as follows: A spacing, approx. 39 to 6 Picas; B approx. 43 to 6 Picas; C approx. 48 to 6 Picas; D approx. 53 to 6 Picas. The 6 Pica unit is not exactly an inch. The line spacing of the machines also follows printers measures. The usual spacings are 9, 10, 11, 12 points. Points will not usually work out evenly to inches. The spacing of IBM and Remington will fit into inches or multiples of inches.



## Conclusion:

All presently available IBM and Remington proportional types can be differentiated. However, all proportional typewriting is not either IBM or Remington. Be cautious in identifying any proportional typewriting which does not correspond to actual machine specimens on hand. Design, character, unit width and spacing may offer clues to machine identity.

## Discussion of Mr. Godown's Paper

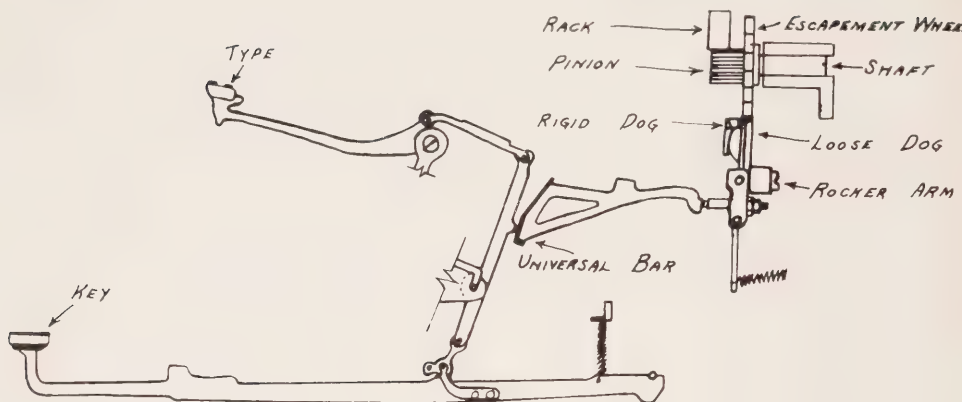
HILTON: Mr. Godown pointed out to us some rather subtle differences in the Remington and I.B.M. types which are basically a headache because of the very close similarity in some of those points, but these very subtle differences are going to be much more useful to us and they would be with standard typewriting simply because these expensive machines are usually equipped with carbon paper ribbons. Therefore, you get a very beautiful impression of the outline of the type and these little flags as Linton calls them, on the serifs of I.B.M. can be distinguished from the more square corners of the Remington. That is about the only salvation to our troubles.

GODOWN: I did want to say something about the utilization of any published material showing typewriter designs with the greatest of caution. For example, the material I have talked about here today. Some of it exists in perhaps only a single specimen from an actual machine that I have been able to get my hands on. That might be a machine that represents what they thought the type design was going to be, and they built one and they typed this material that has been printed, but they may never deliver a machine with that precise type on it at all. That is not true of the *Monotype* design in Remington because we know what they are delivering and it is not true of this material of Justa-riter and Flexa-riter for the most part and of the Olivetti but where I commented in connection with some of these type designs should be remembered that I may not have a representative sample of what the company is putting out and that has been true of all of this investigation into the proportional spacing typewriting. I think that great caution has to be used in testifying regarding the design and the make and model of machines and changes unless one has his own extensive collection of specimens that he has gathered himself. Do not rely on published material.

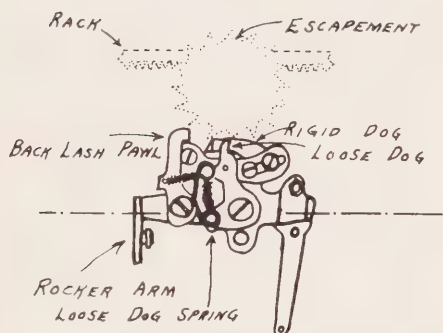
HILTON: Just one other word of caution on that. I found in the course of my studies that some of I.B.M.'s printed material on type design had such anticipated designs that never quite got out on the street. What they were doing was building almost hand-made machines, putting a type on it they were going to use, so that they would have some material ready for publication. Then when the actual machine started through process, a couple of months later the type designers remodeled one or two types. I am afraid that some of these styles, of which Linton has only a single specimen, turned up in six months time slightly modified. I remember some years ago when Remington brought out a standard type of one of their early post-war shaded types that they juggled the type around two or three times within the first year of its existence simply because it was giving them some trouble on machines. It is a good idea to check these early specimens rather closely to be sure that they are really set on what they have.



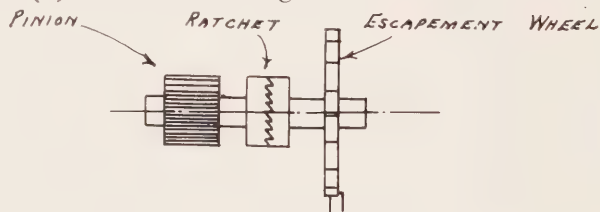
# I. Escapement Rocker Arm Action



## Rocker Arm Assembly



## I (c). Ratchet Fitting



(Figure I)

# Escapement Action of Typewriters

by

DAVID J. PURTELL

Chicago City Police Dept.

Chicago, Ill.

In making an examination of typewritten material, the document examiner considers two types of identifying characteristics, class (general) and individual. The class characteristics are the size of the type, lateral and vertical spacing, and the design of the letters and characters, while the individual characteristics are the defects of type face, spacing and alignment. This paper will discuss only the spacing defects related to the lateral movement of the carriage as it moves from right to left.

When a key on a typewriter is struck, the type face makes an impression on a piece of paper. The carriage then moves a predetermined distance to allow space for the next letter or character to be printed. This movement distance is controlled by the escapement action which is the "heart" of the typewriter." It controls the step-by-step movement of the carriage in order to position each character into its allotted space. When the escapement action is not operating properly the lateral alignment of the type face appears in various ways, the most obvious being crowding, piling and overlapping. These appear to represent only two types of defects but the actual problem is not that simple.

It is believed that the document examiner should consider the individual defects much as would a typewriter service man. After typing a few lines, the trained service man will get the feel of the machine. Upon examining the typed material closely, he will determine the extent of repairs that are required. This paper does not presume that the document examiner become a repair man but it does recommend that he should have a basic knowledge of a machine. With this understanding he would be better able to evaluate the importance of individual characteristics.

In order to consider this lateral alignment problem properly, the writer has classified the principle of escapement action into 1. Rocker Arm designs. This is the writer's analysis of the differences in the actions. However, each manufacturer considers his action very different from all others. In explaining these designs, the writer has taken the liberty of using his own descriptive terms where there were no other terms to be found. In brackets beside the title of each principle are listed the number of the illustrations illustrating the principle under discussion and the make of machine which uses that design. The list is not complete but it does cover all of the typewriters examined as well as those which were studied by the service manuals.

## I. Escapement Rocker Arm Action

(Figure 1)

The principle of this action is as follows: When the key is struck, the motion is transmitted through linkages, or by a part of the type bar, to the universal bar. The universal bar then moves the type face to the left.

arm is pivoted near its center so that any motion transmitted to the lower section imparts a reverse movement to the upper section. The rocker arm mechanism may be mounted either vertically or horizontally. On the top section of the rocker arm are two dogs, one is a loose (or moveable) dog and the other is a rigid (fixed, or stationary) dog. As the rocker is activated, the movement disengages the loose dog which has been holding one tooth of the escapement wheel or star-wheel. This action occurs slightly after the type bar has made the impression. After the loose dog moves out of contact, the escapement wheel rotates and during this interim the rocker arm has moved sufficiently for the rigid dog to engage the same tooth and stop the movement to a portion of a space. The rigid dog serves as a safety factor to limit the escapement wheel to a one tooth movement.

Due to spring tension, the rocker arm is returned to the rest position which causes the reverse procedure to occur. On the return of the rocker, the loose dog contacts the next tooth and limits the movement of the escapement wheel to one full space. The movement of the escapement wheel is transmitted to a pinion wheel which is enmeshed with a rack. The rack is attached to the carriage so that any movement of the escapement wheel is transmitted to the carriage.

It should be explained that the carriage is always under a pressure that keeps pulling it to the left. The function of the rocker arm with the dogs, escapement wheel, pinion and rack is to allow only a predetermined distance to be travelled by the carriage when a key is struck. The distance is determined by the size and number of teeth in the escapement wheel and pinion as well as the number of teeth to the inch on the rack. All three parts must be in proper position to regulate the spacing.

#### A. *Fixed Pinion* (L. C. Smith-Corona and Remington)

In this principle the rack is always enmeshed in the pinion which is attached to the escapement wheel. Any movement of the rack and pinion is transmitted to the escapement wheel and vice-versa. When the carriage is returned (to the right) the loose dog acts as a wheel pawl in permitting the escapement wheel to turn backward. On one machine a silencer moves into contact with the loose dog and moves it down and out of engagement with the wheel in order to prevent a noisy carriage return. When the carriage release lever is depressed, the loose dog is disengaged, permitting free movement of the carriage.

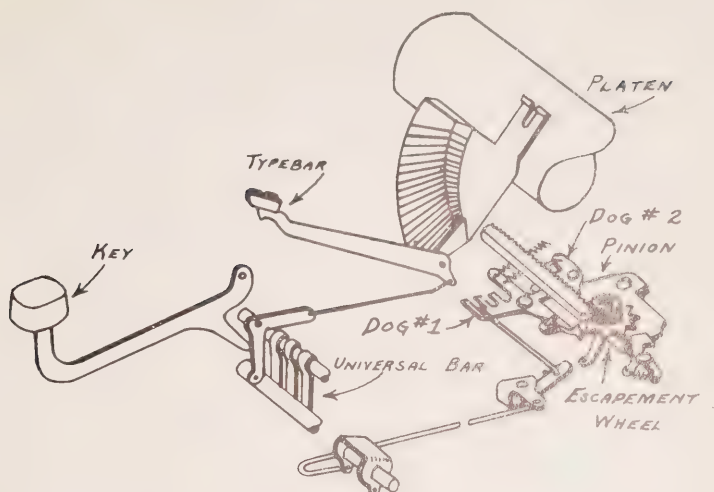
#### B. *Loose Pinion* (Royal, Underwood, R. C. Allen, Olympia, Alpina and Adler)

In this principle the pinion is allowed to turn in either direction while the escapement wheel is held to one direction. This is accomplished by a pawl, attached to the escapement wheel, enmeshed with the pinion under spring tension. The pawl holds the pinion fast and in proper relation to the escapement wheel teeth. The pinion can turn with the escapement wheel but it will be free to turn in the opposite direction when the carriage is returned.

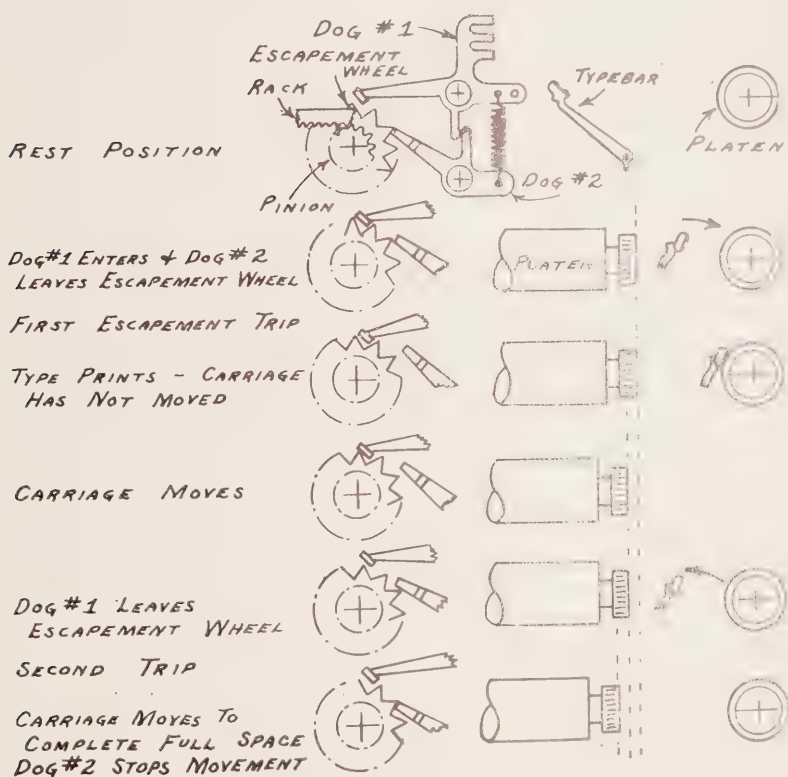
#### C. *Ratchet Pinion Shaft* (Urania)

The shaft which connects the pinion and the escapement wheel has a ratchet fitting. This fitting, while permitting the action of the escapement wheel to be transmitted to the pinion, also allows the pinion to turn freely in the opposite direction. This feature is consummated without the rotation of the escapement wheel.

## II. Lateral Escapement Dog Action



MOVEMENT OF CARRIAGE AND TYPEBAR IN RELATION TO  
ACTION OF ESCAPEMENT DOGS



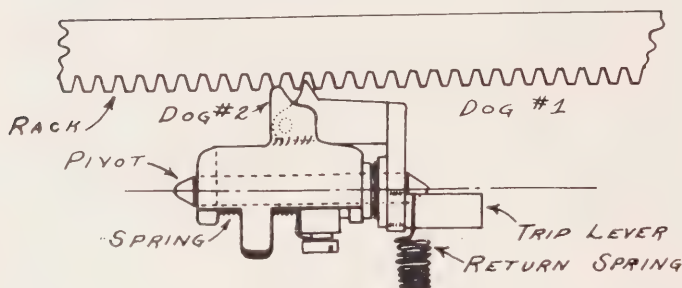
(Figure II)



(Hermes portable, Everest, Alba and Antares Parva)

When a key is struck in this operation, the motion is usually transmitted to a universal bar which in turn moves Dog #1. Before this Dog has had a chance to move very far, the type-bar has made an impression. A finger on this Dog pushes on a finger of Dog #2 which has been holding the escapement wheel. As Dog #2 leaves the escapement wheel, Dog #1 moves into and meshes with another tooth of the wheel and holds the movement to a half space. Through spring tension Dog #1 is pulled out of contact and Dog #2 moves back into contact by means of a tooth. In this latter movement the carriage travels another half space to make the required full space.

### III. Rocker Dog Escapement Action



(Figure III)

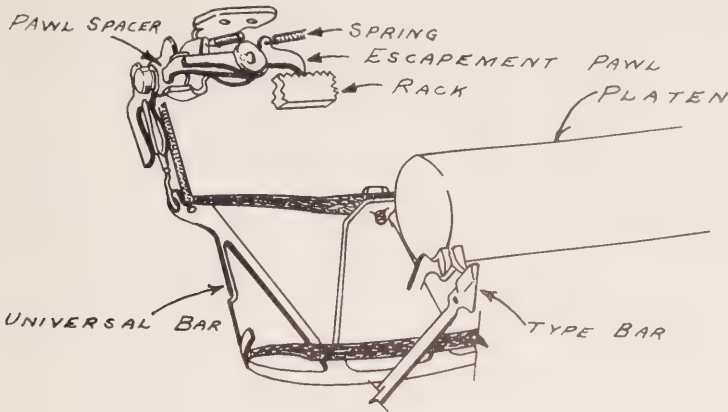
(Cole Steel, early Corona, and Remington portables)

This action consists of two dogs mounted on a shaft which has a pivot screw fitting which allows a rocker movement. This principle eliminates the escapement wheel and pinion but has the dogs working directly on the rack. The action from the keys or space bar is transmitted to the rocker fitting and the dog that was holding the rack is moved out of mesh. The second dog, which is spaced to catch the alternate tooth, moves in and stops the movement of the rack at a stop which is approximately two-thirds of the portion of a space. Spring tension starts the reverse movement, that of moving Dog #2 out of contact with the rack and moving Dog #1 into position in order to contact the next tooth that it formely held. These two movements permit the carriage to travel one full space. The pitch of the machine is determined by the number of teeth in the rack.

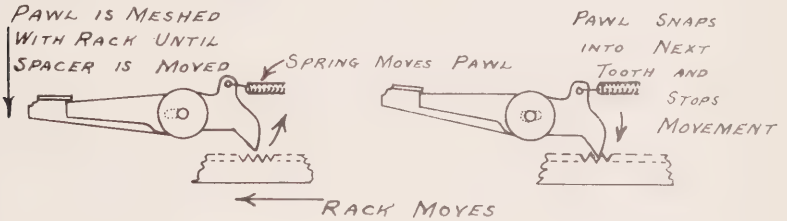
As you probably suspected, this type of action develops defects readily because the dogs are constantly taking harsh treatment from the rack. In addition, all the pressure on the carriage and rack is transmitted to the holding dog.

## IV. Escapement Pawl Action

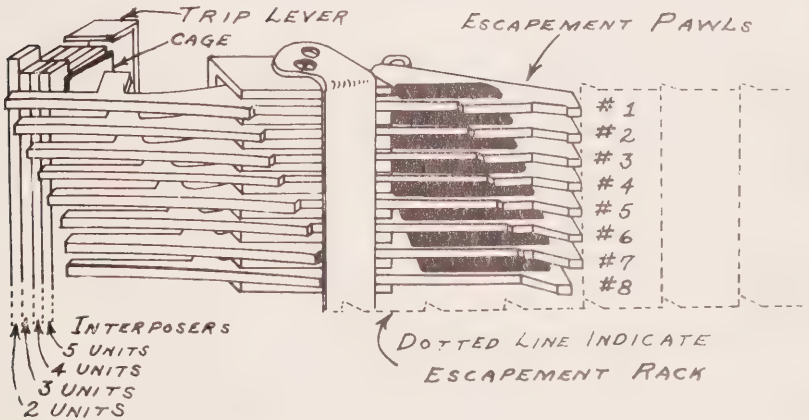
### A. SINGLE PAWL



#### PAWL AND RACK MOVEMENT



### B. MULTIPLE PAWLS



(Figure IV)

#### A. Single Pawl (IBM Standard)

Here, after a key is struck, the action is transmitted to a trip lever which moves an escapement pawl out of contact with the rack. The pawl is similar to a hook in which the edge meshes with a tooth on the rack. When the pawl,

pivoted on an elongated slot, is caused to leave the rack, spring tension pulls the pawl to the right. In so doing the pawl is pulled just far enough to the right to engage the next tooth on the rack. The pressure of the main spring on the carriage and rack causes them to move to the left and also moves the pawl back into position where it is again activated by the trip lever. The teeth on the rack are spaced to the same dimension as the pitch of the machine. Therefore, a ten pitch machine has a rack containing ten teeth to the inch. Early models had a two pawl arrangement whereby the pawls alternated in action.

#### *B. Multiple Pawls (IBM Proportional Spacing)*

This escapement action is designed to permit selection of the proper carriage travel for any width of type character, for instance, "i" requires two units while "W" requires five units. In order to obtain the true picture of proportional spacing, we will have to move forward and away from the escapement action. In proportional spacing each key lever is attached to a cam which in turn is connected to a selector bar. The purpose of this bar is to move a selector bail which will determine the amount of carriage travel that is allotted for the particular type face. The movement of the selector bail will be transmitted thru linkages, rods, bell cranks and finally raises an interposer to the height where it will be pushed forward by the top or blade of the trip lever. Each of the interposers, forming either a two, three, four or five unit, is one unit thick.

The escapement mechanism contains eight pawls, varying in length by one unit of space. The escapement rack teeth are spaced eight units apart, and when a tooth rests on the tips of the pawls, the pawls are pushed on elongated slots so that the tails of the pawls project themselves by varying distances into the path of the interposers.

Since the tails of some of the pawls project themselves in front of the interposers, which are operated by the trip lever, they, (the pawls) are tripped out of the rack depending upon the number of interposers that have been moved. As soon as a pawl is tripped, it is pulled to the right by a spring which snaps it into position where it comes to rest in its new position on the rack before the carriage actually gets under way to move to the left.

Let me explain how this operates: When one of the rack teeth is at rest in such a position as to push the tails of any three pawls in front of the three-unit interposer, which is selected to rise in front of the trip lever, the three pawls thus positioned will be moved from the rack and the carriage will travel three units to the left while under tension of the main spring. The two-unit interposer operates on every tripping action, therefore two pawls trip whenever the trip lever is actuated. The number of pawls that are tripped determines the number of spaces that the carriage travels.

This machine is equipped with a two and a three unit space bar which operate in a similar manner to a two unit character and a three unit character. To this machine is added an expander which causes an interposer to trip one extra pawl. This feature allows for greater spacing between typed letters.

Each principle has its own particular types of defects and instead of listing the defects for each principle, we will concentrate on Group I which comprises the majority of typewriters on the market and those that are in use. First, let us study them with respect to their most important and most glaring defects and their causes as far as the escapement action is concerned. Since this paper is interested in developing the escapement action, we are not including in our list of defects such contributing causes as desk vibration, erratic typist touch, defects in other sections of the machine or defects that are of such a major proportion that they render the machine inoperative.

### Crowding or piling of letters

1. Insufficient clearance between the loose and rigid dog
2. Loose dog not positioning properly on the escapement wheel
3. Escapement wheel or pinion binding.
4. Escapement rocker binding.
5. Escapement wheel binding on the backlash pawl
6. Deep enmeshment of the rack in the pinion.
7. Loose rack.

### Skipping

1. Improper tripping (amount of movement of the rocker arm)
2. Rocker arm not operating properly due to a loose spring, loose arm, or binding on the pivot.
3. Too much clearance between the dogs.
4. Loose dog broken or loose on pivot.
5. Pinion pawl not seated properly or the loss of tension.
6. Worn or broken tooth in the rack, pinion or escapement wheel.
7. Improper meshing of the rack in the pinion, or too much clearance.

In completing the list the writer wishes to include those causes considered by him to be very individualistic and very identifying a particular machine. Some of these, though rarely

Skipping on each line in the same position

Broken tooth in the rack

Same number of spaces between each skip

Broken pinion tooth (will not apply to principles III and IV)

Skipping occasionally in the same location

Worn teeth on the rack (may be caused by excessive wear across the pinion when tabulating)

In principle II, the greatest difficulty will be encountered in the dogs and the escapement wheel, as well as spring tension and adjustment of fingers on the dogs.

As a result of the rocking motion in principle III we can expect defects as those which occur in Group I rocker. Terrific wear on the tooth of the dog and the teeth of the rack since the dog and carriage.

With principle IVa being electrically driven, the wear on the pawl and rack is not as great as might be expected. But we may find a broken or chipped tooth but most of the defects will be due to springs, worn parts, improper lengths of key links, and defects caused by dirt or roughness of the surfaces.

The mechanism in Group IVb is held to very close tolerances. minor adjustments are recommended for the service man to escapement action. Also, a special lubricant is recommended for the interposers. With so many parts and fine adjustments, it is best to list all the defects, one would have to start with the selector bar on to the pawls and racks. To generalize, the defects may be caused by springs, improper tolerances between parts, rough or worn parts, lubricant and tilted pawl block.



## Panel Discussion "B"

October 29

Members: Messrs. Cole, Godown, McCarthy, Thomas.

Moderator: Mr. Hodgins.

### Topic: "Standards and Research"

*Question (1):* What measures might be taken to promote and improve research in Document Examination?

*Question (2):* What kind of research is more urgently required?

COLE: I think that people ought to be more frank about their problems. In the last few days I have heard and participated in some conversations about the study of inks but usually this revolves around studying ink taken from a bottle or ink taken from a fountain pen or ball point pen. You do not hear very often of people working directly with ink on a document or such quantities of ink, that you might be able to take from a document for experimentation. Right there I think that we need a lot of study, particularly in view of the fact that a conclusion about the identity of ink or whether or not a particular stroke has characteristics that would be meaningful to an examiner would have to be supported by a good deal of research. There would have to be a sort of a statistical basis to support a conclusion. There ought to be a lot of thought about how much information can we get from an ink stroke without changing the paper in any way such as examination, say through various colour filters, subsequent study of the photographic record, say by means of a densitometer, study of that same ink stroke under infra-red and under ultraviolet, perhaps further study under monochromatic light sources. We ought to approach that problem from what we can learn about ink on paper without changing the document which is a limitation that we almost always have to observe.

HODGINS: The possibility presents itself of an organized research program which could be set up among a group like ourselves. What would be your ideas concerning this?

McCARTHY: Well, it is feasible but not overwhelmingly possible. Distance is the big factor, a problem of communication trying to inter-relate isolated branches of research being conducted on approximately the same subject in various parts of the country. We must rely on the various journals which apply to this subject.

HODGINS: To come to grips with the second question, which we are making part of the first now, Mr. Thomas, what are your views on the kind, type of research which is most urgently required?

THOMAS: There are two or three things that should be the type or kind of research that I feel to be paramount. One of them is not strictly research as such and that is the problem of finding trainees or individuals who would be adaptable to pursuing this profession. We touched on that subject last night and I think that inasmuch as we are all fearful of charlatans entering the field it should be our prime responsibility to find young individuals who are interested

in the profession of document examination, to search them out and try to train them or perfect them in such a manner that we would not have to worry about so-called charlatans. My feeling is that there are two basic requirements, over and above scholastic ability. One of them is that an individual must have a dedication to the work; he must be interested in it, wholeheartedly apply himself to it full time and be dedicated to it, scrupulously applying the rules and principles and regulations that we adhere to. The other is that he should have some analytical ability and reasoning power, to arrive at a proper conclusion to arrive at what is most nearly the correct answer. I would like to compliment publicly the R.C.M.P. for this seminar. I think it is the beginning of something that is badly needed, internationally, especially in the North American continent and although the travel limitations will hamper us somewhat, I believe that State Police Organizations in the States and various police departments and even informal gatherings of those out in certain countries would thrash out a lot of the problems as we have here and would lead to a better understanding of the subject.

HODGINS: We frequently hear questions raised as to whether our own members who may not be very well versed in matters of chemistry, and other technical fields, should undertake research in some of these matters or whether they would be more wisely left to those who have a more specialized background. What are your views on that?

GODOWN: In order to conduct research successfully in a specialized subject you first have to have a knowledge of what is needed, and you have to have a genuine interest in the subject. Where you have a staff of people with a technical background there are some projects that you can assign to a person with a specialized background. But his specialized background may not be as valuable and effective in well guided research toward a practical end, as would be that of a person who was thoroughly conversant with the problem but had less of a specialized background in, say chemistry. Mr. Cole mentioned the problem of dealing with ink writing as it is on paper as opposed to ink in a bottle and that is a type of problem that only the person who deals directly with document problems appreciates. If you have a vital interest in it and an inquiring mind, sometimes the technical knowledge can be acquired and produce more useful results than if you make use of a technician. I think the question may be answered both ways, sometimes a technician would be better, sometimes a person with a vital interest in the subject would develop to a better advantage.

COLE: Just a few minutes ago I commented upon the tremendous amount of energy that is put into the collection and classification of typewriting specimens individually, which certainly suggests that there ought to be some central bureau that could take over the collection and classification of types, of specimens, publish information about them, make them available to other people, and I think that that would be useful enough to various groups to make contributions to the expense of operating such a bureau. As to method, just a rather casual thought, I believe that Interpol is supported by contributions from various governments. Perhaps they could take over such a project.

GODOWN: I think that there has been some thought given to the idea of trying to raise funds from private sources who might underwrite a project of that nature. I do not think anything successful has evolved. The difficulty is, first in money and second in getting the quality of personnel that you would like to have. It is difficult to get a man with the proper background if you have funds.

MCCARTHY: I would like to call the attention of this meeting to some recent publications in the field of statistics, specifically on sample statistics

which are used in psychology. The only purpose of the small sample statistics is sort of to back you up in the event you have a hunch. I have on occasion wondered why certain troops on the New York State Police seem to use the facilities of the laboratory more than others. It is just a hunch I happened to get at a particular time but I asked myself, "Is this just an impression I am getting or do I have some sort of a good statistical grounds for believing it is true?" Small sample statistics can be used with numbers under 50 and does not involve very complicated mathematics. You can, through random sampling and the other usual controls, determine whether or not there is any grounds for you believing a certain hypothesis. Small sample statistics will not help you as to cause but it will back up these hunches you get. You can also use it on actual problems because you do not need cardinal data; you can use ordinal data where you can merely rank it, or you can use nominal data or you can just place it in a specific group. By nominal data, I mean a "yes" and "no" type of answer. I found for example with this that the tendency of a person writing a cheque, who uses a fraction, to change to a decimal is much greater than the tendency to go in the opposite direction. In other words, a person who normally writes the amount as a decimal is less likely to change that style to a fraction on another cheque than the other way around.

### Discussion open to the floor

BOONE: Mr. Thomas, in connection with your ideas on some tests, I wonder if any of you Canadian gentlemen have had any experience with some of these tests which firms in the United States, Johnson O'Connor Research is one of them, have prepared to test individuals for business concerns and others. Has anybody ever given any thought to a combination of those tests which might point out a particular individual's adaptability for document examination?

THOMAS: I had in mind that we should all be on the alert to try to encourage some young fellow who might be in some field of investigative work or in some laboratory who might have special capabilities to become a document examiner. There are a lot of young fellows in police science schools of various universities who may have the potentiality. I know the scarcity of applicants for these jobs. I personally know of several openings in the States that have gone begging for some time because men suited for the jobs were not available.

HUBER: We should bear certain things in mind with regard to these different types of interest or aptitude and ability tests and that is the fact that there is a great deal of work yet to be done on them in order to test their reliability and validity in the application of any one of them in a specific field. It almost requires someone with an extensive knowledge of the field to devise a set of tests or test which is going to be the most suitable for the field in which it is going to be applied. A year or two ago, Mr. Duke conducted some brief experiments with a form blindness test which might be applied to new members in the field using, not the conventional symbols but actual specimens of writing. This requires a great deal more work to iron out a few snags but Don mentioned, at one time, a battery of tests, using some of the available tests plus some specific ones which might produce a composite that would measure a cross-section of the potential that we need in document examination. I think this is something that would be very worthwhile, but it is going to take a lot of work to develop it.

I was wondering whether any members of the panel felt there was any merit in a program for presenting some of our problems in a detailed form to graduate schools as research projects. I am thinking in terms of statistics, psychology, chemistry and so on.



THOMAS: Such problems presented to Dr. Paul Kirk might get some research done. He has students working on those problems a considerable amount of time and most of their findings are published.

McCARTHY: The problem with document examiners is that of getting some sort of known, something you can measure by, some aptitude which is outstanding in successful men for which you can look in your new recruit. Any such program involves contacting the most successful men. The personal contact factor is very necessary because a great number of the tests are run on some time basis and so forth. The only two places in the North American continent that a person could test a fairly large number of successful document examiners would be in the City of Washington or that area or the City of Ottawa and that area.

**Question (3): What collections of standards are essential to document examiners and what other collections are desirable?**

COLE: I would say that a person certainly ought to have a wide collection of all the materials that enter into the production of a document, writing instruments, inks, papers, anything that might be found on a document or that might impinge on a document, staples, pins, seals, ribbons, anything that one might encounter in handling documents. He ought to have them in order to study their characteristics, not necessarily with the idea in mind that he could collect a sample of absolutely everything that he would encounter, but more or less as representatives of a class.

GODOWN: With respect to typewriting samples I think it is quite essential that one have a comprehensive collection of specimens taken from actual machines that he himself has taken, particularly the significant ones. That would indicate changes in design so that he himself has actual examples of the designs used by the different companies in the more recent period. It is not very essential that you have those of 1910 and 1912 because you do not encounter those machines. Sometimes the best source of evidence as to the date of change in design would be the typewriter people but they are not the best witnesses and they are very reluctant to appear in court, and by having taken your own specimens or having your own reference files it is possible for you to rely on your own knowledge when certain design changes took place from specimens from machines of which you yourself read the serial numbers which put you in a better position to serve the needs of identification. That is one difficulty that would arise in having a central bureau prepare the information and collect it. Perhaps it would be acceptable, but if individuals take specimens from the stand point of presenting evidence in court they are then relying on their first-hand experience, there has no taint of hearsay to it or possibility of other people's error. Of course, the reference specimens that you should have are so many that it is almost impossible to gather them all, sometimes you gather them by exchange.

THOMAS: I feel it is important, as Mr. Cole mentioned a while ago, to have at least a good sampling of the various writing fluids, of all the national and international manufacturers but of course to have all of them would mean that you would have to have a very large staff to meet the cost of those new materials which came out. We are handicapped in this entire subject matter in research and in standards because of the lack of personnel and the lack of time to be able to pursue all the things we should do. I think there would be only one or two people in this room who could admit they are actively pursuing one good research project, simply because of lack of time. The current work load requires you give your full time and attention to your current cases and you just do not have the time to pursue it.



COLE: We ought not to talk about lack of time or lack of facilities because exploring the need for these things would be one of the ways to get the time. In other words, if you establish a need for certain lines of research, then you may be in a position to say I need additional employees to do this work or I need the money to carry this forward. An idea I had is this, that there are changes everyday in the document field, there are new materials, new machines coming on the scene and the document examiner ought to stand ready to advise people about the use of this equipment or certain implications that may be involved in the use of new equipment. Nowadays, documents are being produced almost without being touched by human hands. We have machines that turn them out at a great rate then they are used in a certain way and then they are processed by machines. The matter, for example, of validating a cheque by signature is changing right now. When you have machines handling cheques drawn on tabulating machine cards, the machine is not expecting a signature so the question arises may you not need some new method for validating documents other than a signature. Another point, the use of so-called office copying machines is increasing day by day. The machines are inexpensive, very light, portable and easy to use. They do not produce a very good copy but the use of them certainly means that there are going to be more and more cases where the document examiner might be limited to the use of such a photo-copy for his examination and if he thinks it is a serious problem, he ought to do something to discourage perhaps the extension of their use or at least to be ready to advise people about the kinds of difficulties they might encounter if they use these machines. There is one particular machine which you can never be certain that a copy produced by it has everything that is on the original document because it fails to copy most coloured inks.

### Discussion open to the floor

SOMERFORD: The question has come up in court about our assumption that handwriting identification is based upon the principle that no two people write identical hands. That being the case, then the next question might be what research, if any has been conducted, to explore that point. With that in mind, an effort has been made to pursue this by collecting specimens of approximately 500 sets of identical twins, with the thought that since they are identical in other respects it might be the best ground for exploring this subject. This material has been accumulated, but unfortunately for the lack of time, no actual evaluation of it in comparisons has been made at this time. Another point that I think is of interest would be the collection of specimen handwritings of individuals in different age groups as well as of individuals before and after they suffer a certain illness or condition that would affect their writing. That is a very important item in our accurate evaluation of certain conditions that may be present. I would also like to mention the continued collection of copies of handwriting systems that may be available for purposes of study, because all of our principles of identifying handwriting is based upon the departures of the writing being examined from the norm or the copy book styles. If we are not conversant with the styles as such or the basic patterns how are we able to properly evaluate certain conditions that may be present. For example in the Blozer system of handwriting which emanates from Virginia, we have a design of the small letter "k" which is made in two separate strokes, now someone that is not familiar with that system of handwriting when they find a small "k" which is split, might consider it as an individual characteristic when actually there is a system which employs it.

McNALLY: In line with the thinking of gentlemen on the panel regarding the use of graduate students in doing research on document problems. Research,

to be handled by a laboratory engaged in law enforcement would require that the laboratory has the time to do research. I find that in our own laboratory in New York City and I would not be surprised if it happens in every law enforcement laboratory, the burden of the day to day work is so tremendous that there is little or no time left for research, and I can imagine that a man in private practice is strained too. The collection of adequate standards of type-writing and paper could somewhere along the line be handled over, since it is a comparatively simple problem though detailed work to a police science program. I think there is a graduate program at the University of Michigan and there is one in the City College of New York. There is a possibility that it could be done through the American Academy of Forensic Science, possibly through a grant from the Rockefeller foundation. At least the American Academy is engaged in a legal forensic work and in law enforcement work and they could fill at least that requirement plus the fact that they have publication which I think is another requirement for a grant from the Rockefeller Foundation. Research itself is such a tremendous problem in this field that it would have to be handled independently by somebody, some organization which has the time for it.

GODOWN: I would like to throw a thought out here. We are in the profession that came about and reached its present stage of development because due to the fact that there were a number of people who undertook to sacrifice their own time and to think in terms of developing and doing research. Now it is very easy in thinking about anything like research to think in terms of what "they" ought to do. They being the vague other fellow who does not have problems of having to work and earn a living and play golf and watch television and play bridge and drink a few beers. What we need to think about is not what "they" can do but what "I", myself by devoting some hours of my time can do to advance my profession. It is only a professional who is willing to recognize that you must contribute to it and I think you get away from thinking about what "they" should do and what "big boys" should do and get down to what can "I", personally do as a contribution, (this is not directed to anyone, I am talking about myself too), then I think you begin to accomplish various bits of research that can be exchanged and become of some value. Of course, it is nice if you can get a foundation to put up a half million dollars.

SOMERFORD: I think the remarks of Mr. Godown are very well taken because the advances that have been made in the field in the past have been greatly due to the individual efforts of the examiners that have preceded us and to many of those now actively engaged in it. It is a responsibility that we owe to ourselves, to the public and to the people we work for to advance it on an individual basis primarily, and then if we can seek support elsewhere it would be very advantageous. If we have it done by someone else, we do not reap all the benefits of the work that is involved, and perhaps there may be some way when anything is accomplished to make it so that everybody can benefit from it.

M McNALLY: In my remarks on research I meant to call attention to the fact that I downrate the fellows who in starting a new profession did not engage in a lot of research. However, research in any large organization and in any profession, in many instances is conducted by people who are engaged in the research. Research in general does not always have to be conducted by the man who is applying these principles in his work on the field. For instance, the Bell Telephone research laboratories are engaged only in fundamental research methods, and these new methods are applied by other people who are doing the practical work. In the legal profession you have the same thing. You have

into legal problems that is conducted by people who actually do not apply it, again in chemistry, in every field. Of course, it is nice to say you put your own time and effort into these particular things. In a law enforcement agency you are constrained by certain difficulties, you have to do certain things, you have to turn out the work, and research is always secondary. It is not the case of you deciding what you are going to do, you have to do exactly what you are told to do. In governmental agencies you have to depend in many instances on research done by other men.

DUXBURY: I think research has to be met half-way. There is no definite dividing line where somebody else will do the research and you will take their findings. This applies to typewriting, especially. I think half the battle in learning them is collecting your own standards. If you accept what somebody else has taken you do not gain the value of the research which you have had to do in obtaining those standards, and as Mr. Godown mentioned, one further reason is to obtain the direct evidence which is of value in court.

## Unique Document Problems

A. W. SOMERFORD

Bureau Chief Postal Inspector

Washington, D.C.

As a representative of the United States Post Office Department, I permit me to take this occasion to pay tribute to one of the world's most honored and respected law enforcement agencies—the Royal Canadian Mounted Police. They stand as a symbol of man's desire to live in a world where truth, justice and freedom prevail. The thirst for the rights and dignity of man can never be quenched and will last as long as there is life itself, but without the will to uphold these principles, they cannot long endure and will eventually be destroyed. The "Mounties" protection of the sovereign rights of the people of this great Dominion exemplifies all that which is desirable in law enforcement.

My Chief, Mr. David H. Stephens, head of the Post Office Inspection Bureau, requested that I convey his personal greetings to this assemblage and extend to you his best wishes for a successful conference.

Those of us who are present here today from the States, are privileged by the privilege of participating in this important conference on Exchanged Documents in Crime Detection.

The various representatives attending from other countries, through their very presence here the mutual interest that prevails among the law enforcement bodies of democratic nations in the open discussion and exchange of techniques entailed in this exacting and important phase.

In order to discharge with optimum efficiency the responsibility placed upon us, we must continue relentlessly to explore and test new methods which will contribute to the field of criminal identification.

In the solution of "unique document problems", rarely can one rely on textbooks for guide-lines. Instead, the examiner must depend upon his own important attribute, the element of judgment, in searching for the clues that may ultimately spell "Evidence".

When one of our postal employees, in the course of his duties, discovered a tacky condition in the engraving ink on postage stamps, counterfeiting was immediately suspected. Laboratory tests proved the stamps were genuine. The odor of cedar detected on the stamps, they may have been previously kept in a cedar chest as oil of cedar is known to attack inks. Further investigation confirmed what was suspected.

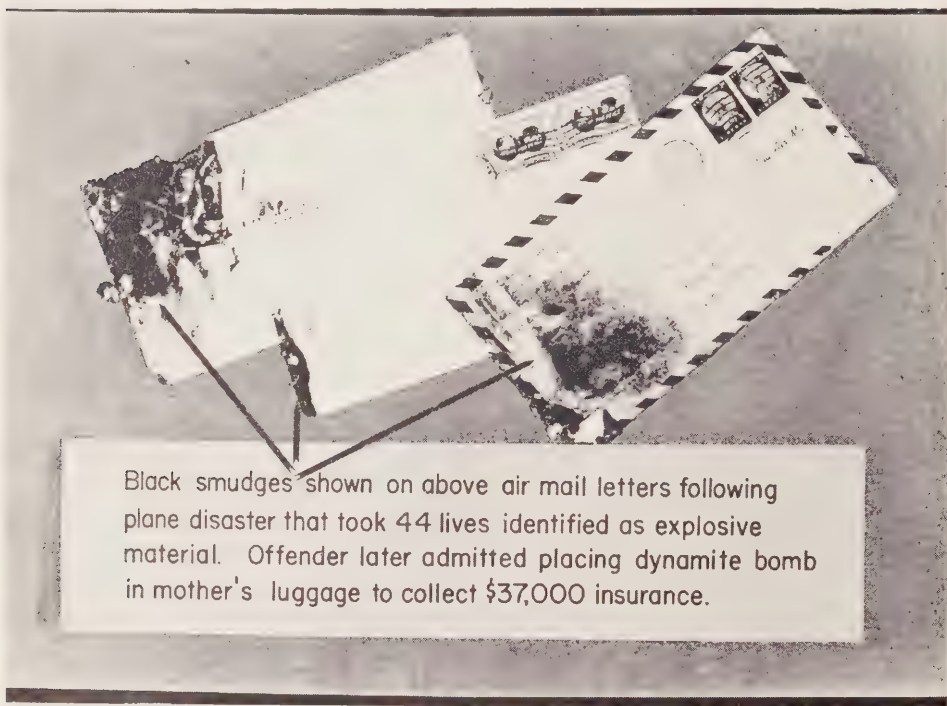
The editor of the "Army Times" in Washington hurried to the Post Office upon discovering that three entries in a contest sponsored by his newspaper had submitted identical perfect scores. The case was promptly checked by the register of postal employees which revealed each of the contestants worked in widely separated post offices and had surreptitiously pre-dated postmarks to their entry letters.

When, as occasionally happens, handwriting, typewriting or other methods approaches fail, it may be necessary to invade other fields for the solution. This was the situation when the writer of a series of anonymous letters could not be identified principally by the handwriting.



about twenty typewriters. By chemically processing some of the subsequent anonymous letters, a fingerprint was developed which was identified with a suspect of long standing, and the investigation was concluded.

The topic selected for this Seminar, "Unique Document Problems" was prompted by initial experiences in document cases submitted for examination. More specifically, the examinations then conducted were being confined to the particular problem presented, overlooking the fact that some investigators may not be entirely familiar with the many other facets of documentary evidence that may be present in a given case. With this in mind, slides have been prepared and will now be exhibited covering cases that are believed to typify what can be achieved by the document examiner when his margin of thinking is extended beyond the problem presented. (Mr. Thomas has kindly offered to operate the projector).



Slide No. 1

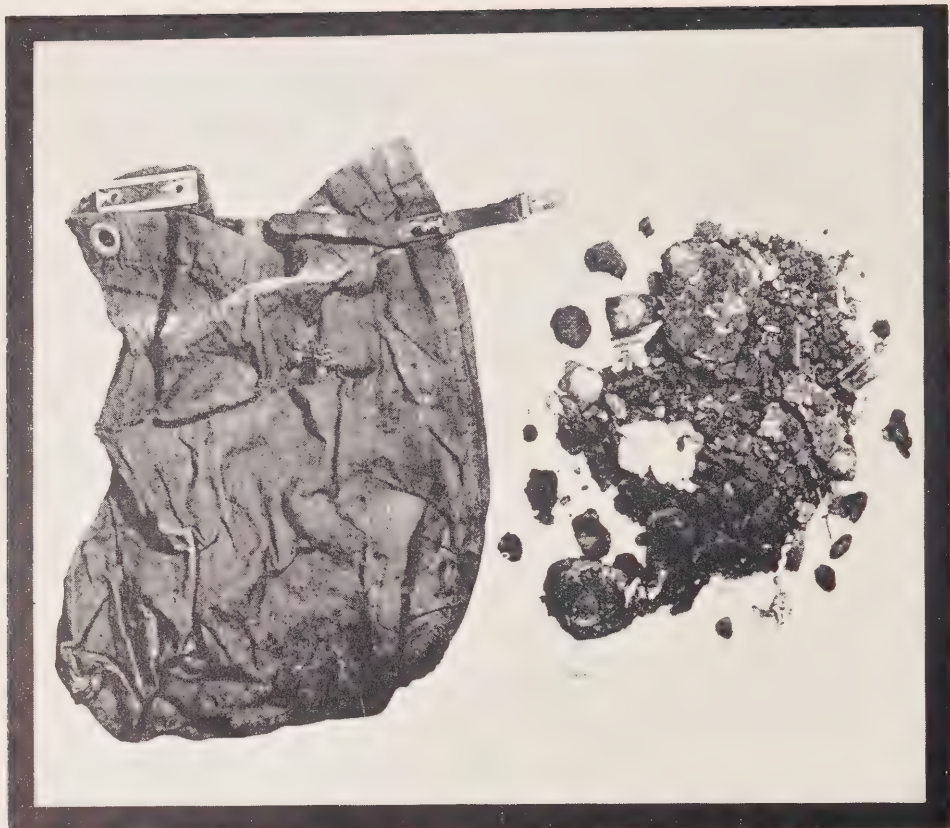
The dark smudges on the three air mail envelopes illustrated were identified by chemical analysis as explosive material, following a commercial plane disaster which caused 44 deaths. The son of one passenger later admitted placing dynamite in his mother's luggage to collect \$37,000 insurance.

# COMPARISON CHART

| Questioned         | Standard           | CORRECT SPELLING |
|--------------------|--------------------|------------------|
| <b>BOUDY</b>       | <i>Boudy</i>       | BODY             |
| <b>CAR PenDaiL</b> | <i>carpen daiL</i> | CARPENDALE       |
| <b>CentS</b>       | <i>cents</i>       | SINCE            |
| <b>decen</b>       | <i>decen</i>       | DECENT           |
| <b>CoUNT</b>       | <i>Count</i>       | DOCT             |
| <b>HunDer</b>      | <i>Heender</i>     | HUNDRED          |
| <b>KenOW</b>       | <i>Kenow</i>       | KICK             |
| <b>ReMBer</b>      | <i>Rember</i>      | REMEMBER         |
| <b>Runing</b>      | <i>Runing</i>      | RUNNING          |
| <b>WorNiNg</b>     | <i>worning</i>     | WARRING          |

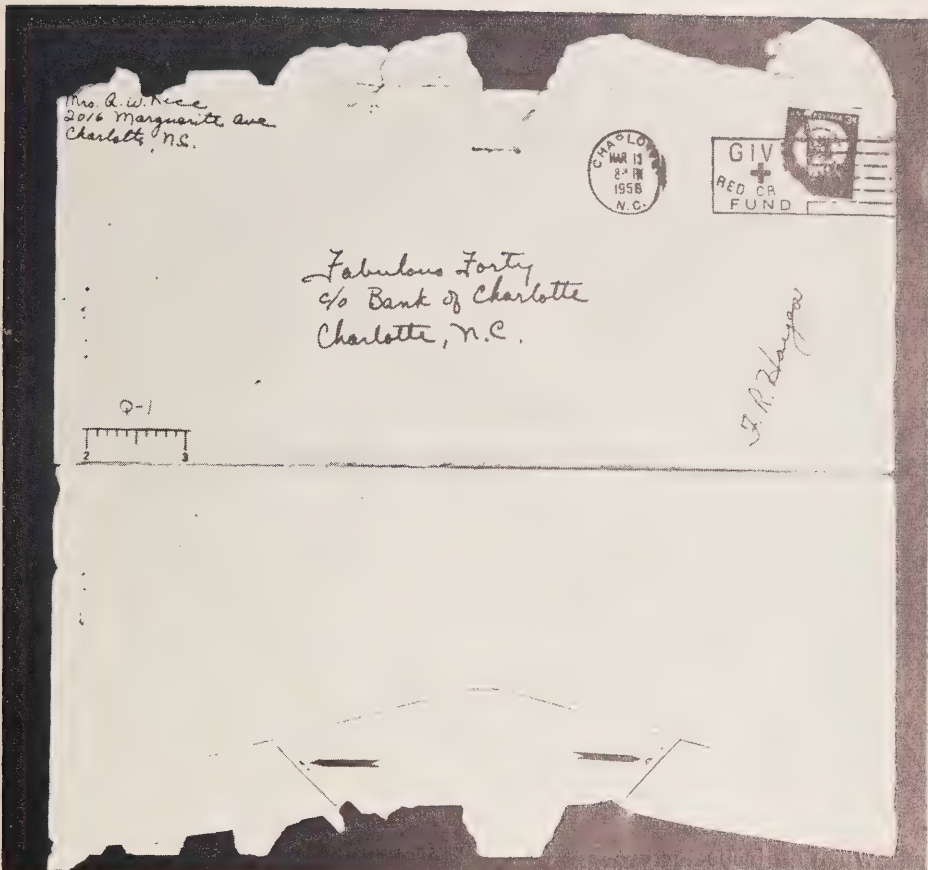
Slide No. 2

Despite unique efforts to remain anonymous by concealing destinations of messages on postal cards using individual letters cut from newspapers the gross misspelling served to pinpoint offender.



Slide No. 3

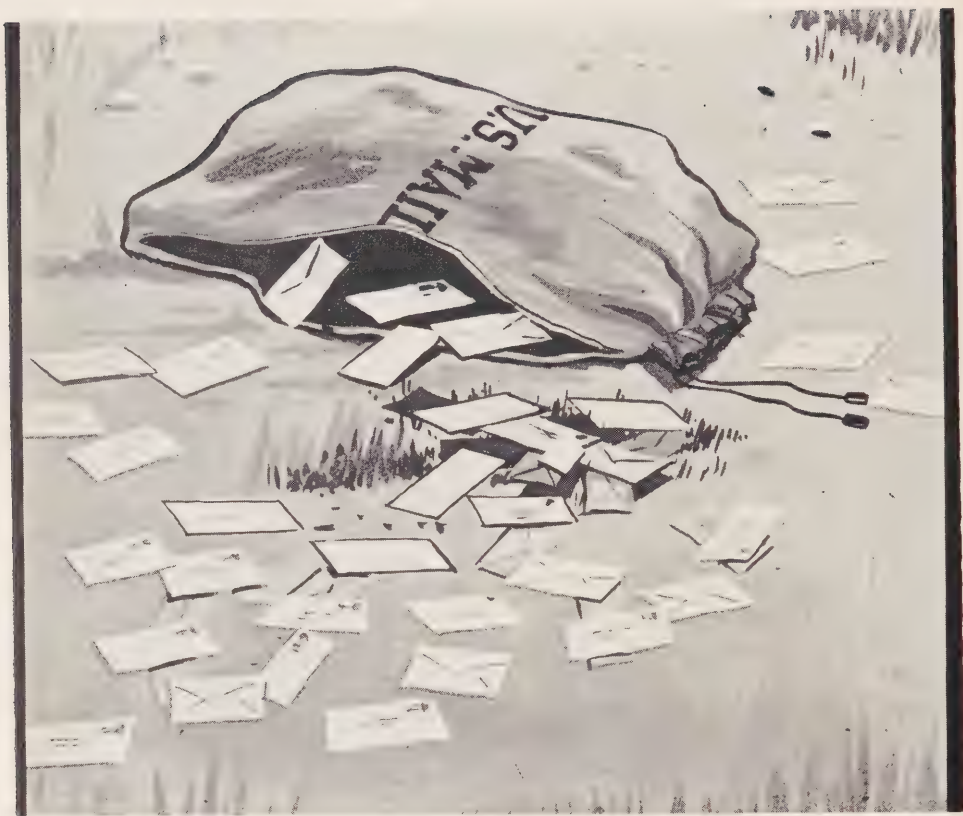
This air mail pouch was found saturated with water near a street mail box on a rainless day. The laboratory was asked to determine the cause of the wet condition and time of occurrence. It was established by the presence inside of the pouch of a twenty and a five dollar bill and two sections of string of the type normally used in tying bundles of letters, that theft was not the motive. Decipherment of one postmark established the sack of air mail was intact 24 hours preceding discovery. The remaining mail matter reduced to the semi-pulp condition shown, suggested the mail sack had been caught in a mechanical street cleaner which accounts for the tumbled and pulp condition of the paper contents.



Slide No. 4

The problem presented in the next slide was to determine possible irregularity regarding the envelope flap. Examination revealed minute traces of black cancelling ink at the two points shown next below the border of the sealed flap. When the laboratory specialist vertically cut the flap at the points indicated and raised the paper he found black ink deposits under the sealed flap, establishing that the letter had passed through the post office cancelling machine with the flap folded inside for the obvious purpose of obtaining a pre-dated postmark.





Slide No. 5(a)

When an inspector brought this sack of 426 pieces of rifled first-class mail to be processed for fingerprints, he was unaware that his thoroughness in collecting all of the torn items found scattered in an open field would be rewarded by a speedy solution of the case. While examining the torn mail prior to the fingerprint processing, the business card of a major local firm appeared to have no connection with the rifled items. It was further surmised as unlikely that anyone would mail a business card in a soiled condition. A pencilled number on the back of the card drew special attention. Could this card have been dropped by the offender? The answer soon followed when the postal inspector hurried to the firm in question, presented the card, and inquired whether the pencilled digits had any significance. "Yes", responded the firm's representative, "each time anyone applies for a position we prepare a file and assign a number which is also written on one of our business cards furnished applicants to expedite status inquiries". Examining the file that tallied with the numbers on the recovered card, the inspector obtained the necessary particulars and confronted the culprit who, expressing amazement, readily admitted stealing the mail sack from a relay box.



**JANE K. SMITH**  
PERSONNEL REPRESENTATIVE

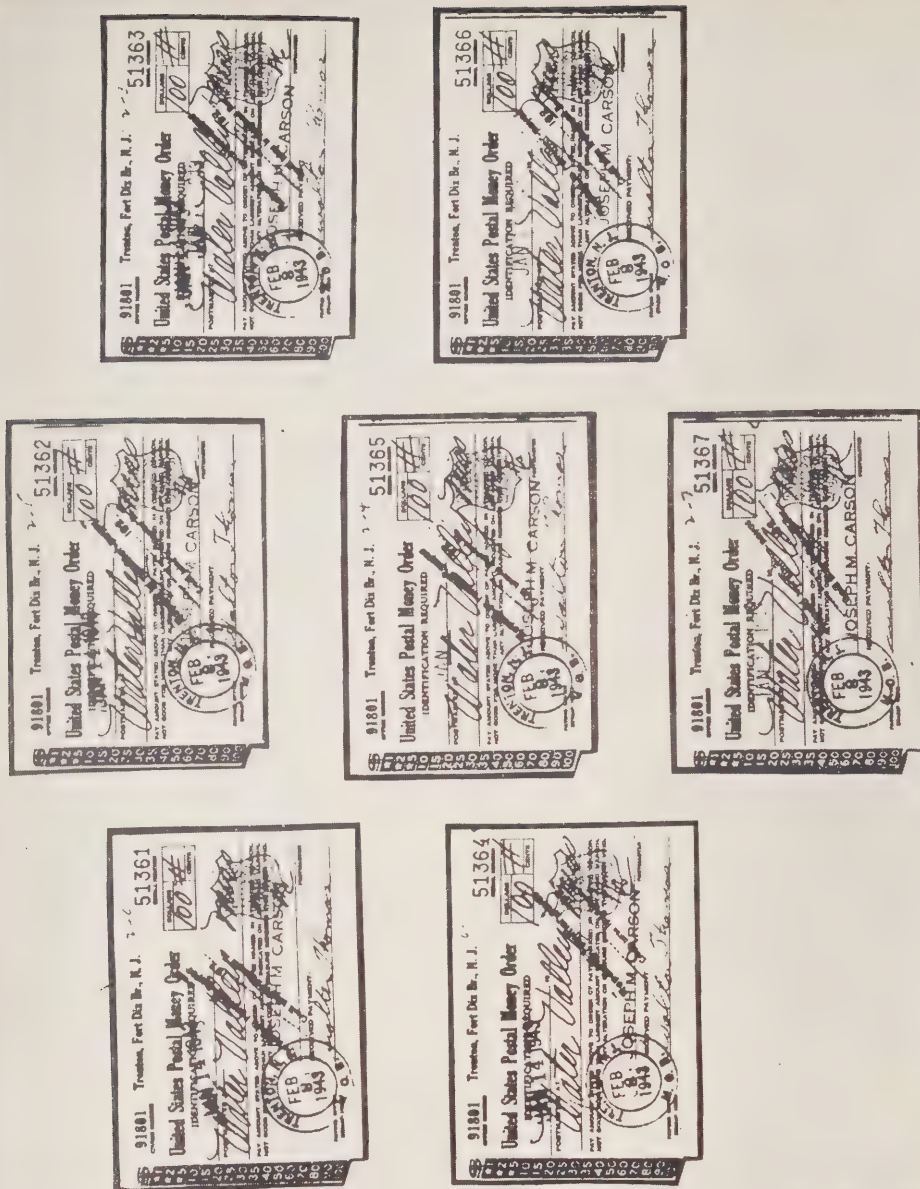
**MELPAR, INC.**  
1411 S. FERN ST.  
ARLINGTON, VA.  
OT 4-7800

SUBSIDIARY OF  
WESTINGHOUSE AIR BRAKE CO.

Slide No. 5(b)

FILE # 2365

Slide No. 5(c)



Slide No. 6(a)

At one of our larger Army installations a soldier received an alert for overseas duty. Fearful that the \$700 in his possession might be lost or stolen, he prevailed upon a sergeant on the post to purchase seven money orders in amounts of \$100 each, payable to his sister. The sergeant obliged and even offered to mail the orders. Shortly thereafter in France the soldier was dismayed upon learning that his sister had failed to receive those orders. Handwriting specimens from several possible suspects produced negative results. Concentrat-

# COMPARISON CHART II

Questioned Writing

1. Walter Thomas

F.O. 51366

2. Walter Thomas

F.O. 51366

3. Walter Thomas

4. Walter Thomas

5. Walter Thomas

6. Walter Thomas

7. Walter Thomas

Standard Writing

Walter Thomas

Walter Thomas

Walter Thomas

Walter Thomas

Walter Thomas

Walter Thomas

Walter Thomas

Slide No. 6(b)



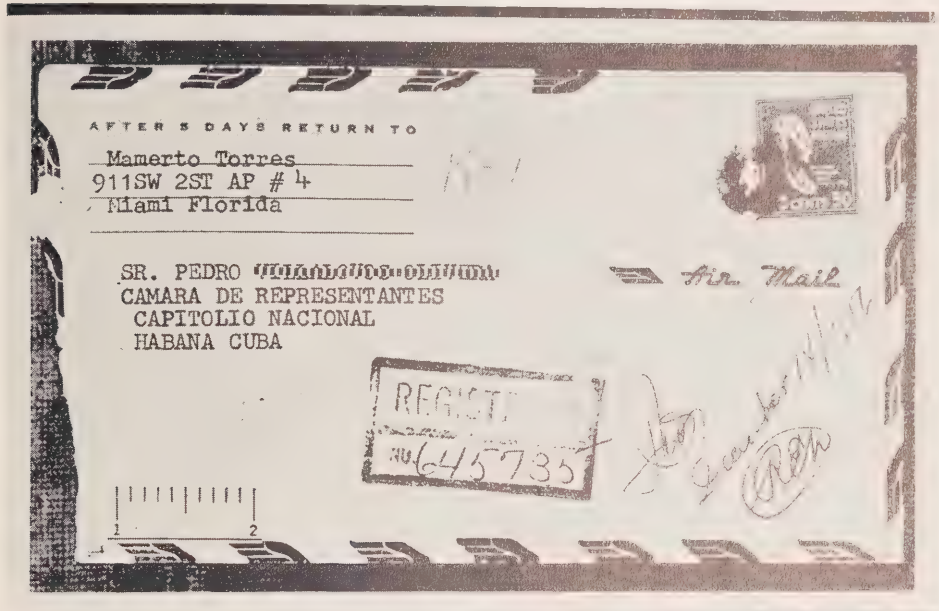
ing on the endorsements the document examiner wondered if the misspelling of the first name Walter as Waltor on six of the orders could have any significance. Perhaps, thought he, the forger's first name ends in "tor" and subconsciously wrote Waltor when signing the orders. Examination of the service records of the 96 sergeants stationed at the post during the month the orders were purchased revealed one named Victor Holeman. The "tor" matched the handwriting on the orders but additional specimens were deemed necessary. The following slide illustrates the striking handwriting agreements which served to identify the sergeant.



Slide No. 7

In the examination of anonymous letters, generally the handwriting or typewriting comparisons serve to identify the offender. In borderline cases corroborative evidence may be helpful. This slide illustrates a new approach which can be utilized when an anonymous writer happens to place lipstick

impressions on letters. Agreements in the dermal ridges of lips, like those in fingerprints, may provide the solution. The soundness of this method of identification has been confirmed by experiments conducted. In other types of crimes where lipstick impressions are found on drinking glasses, etc., evidence of this kind could be important.



Slide No. 8(a)

Postal inspectors are also responsible for the investigation of extortion letters demanding money. The next slide reveals the registered envelope of a letter demanding \$10,000 from a high official of another country. The suspect admitted typing the envelope but denied authorship of the typed enclosure claiming the addressee had written and inserted the incriminating enclosure, in revenge, after receipt of the letter. Although the size and design of the type-writer type on the envelope and enclosure matched, the machine was so new as to be devoid of the essential identifiable defects in the type faces. However upon examining the enclosure further for other possible clues, impressions were detected at one point on the paper which corresponded with the registered number on the face of the envelope as written by the postal clerk with a ball pen when the suspect registered the letter.

Estimado Sr.

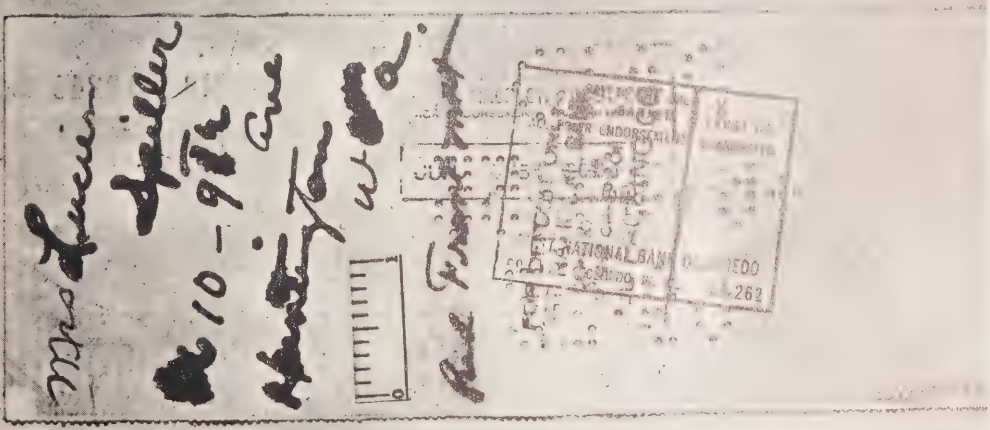
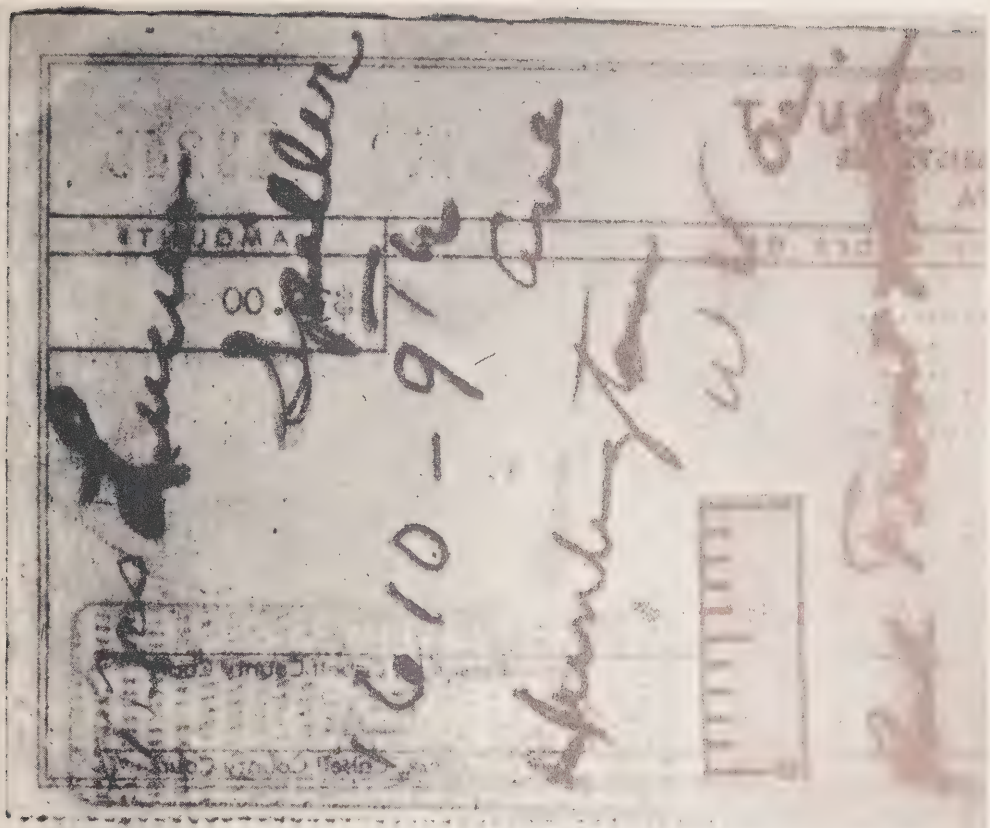
Por la presente vengo a informarle que despues de convencerme de que lo mio no tiene arreglo es que me decido a vender mi silencio, pues son muchos los que piensan que usted me mando a matar pero sin embargo yo nunca he hablado sobre ello pensando que lo mio con su hija tendria arreglo pero he esperado mucho y hasta casi me cuesta la vida sus aberraciones y sus faltas de escrupulos ~~pero~~ asi pues al llegar al convencimientos de que mi salud no me permite seguir trabajando como estoy es que me decido a pisotear mis sentimientos para con su hija y venderle mi silencio y el honor de suhija que ene estos momentos esta en mis manos.

Yo no pretendo hacerle daño a los suyos solo quiero salvar mi vida que ya esta bastante maltrecha, yo espero que usted se de cuenta que yo no tengo nada que perder y que con un escandalo usted si lo perderia todo el precio de mi silencio es minimo pues solo quiero lo necesario para poner un negocio y no tener que trabajar duro solo es \$10,000 y tan pronto los tenga usted recibira las otras fotos con sus negativos son 5 y las tengo hasta autografia- das por su puño y letra, bueno ella podra informarle aunque le digo que ella no es culpable ni yo tampoco solo usted que echo a perder todo lo bueno que habia en nosotros y ahora justo es que pague en algo sus culpas. El dinero lo puede mandar en giros postales de \$1,000 al 911 SW 2 ST AP#4 Miami Zona 36 Florida. 1,000

Mamerto Torres.

11/17/56  
December 14/1956  
RCH

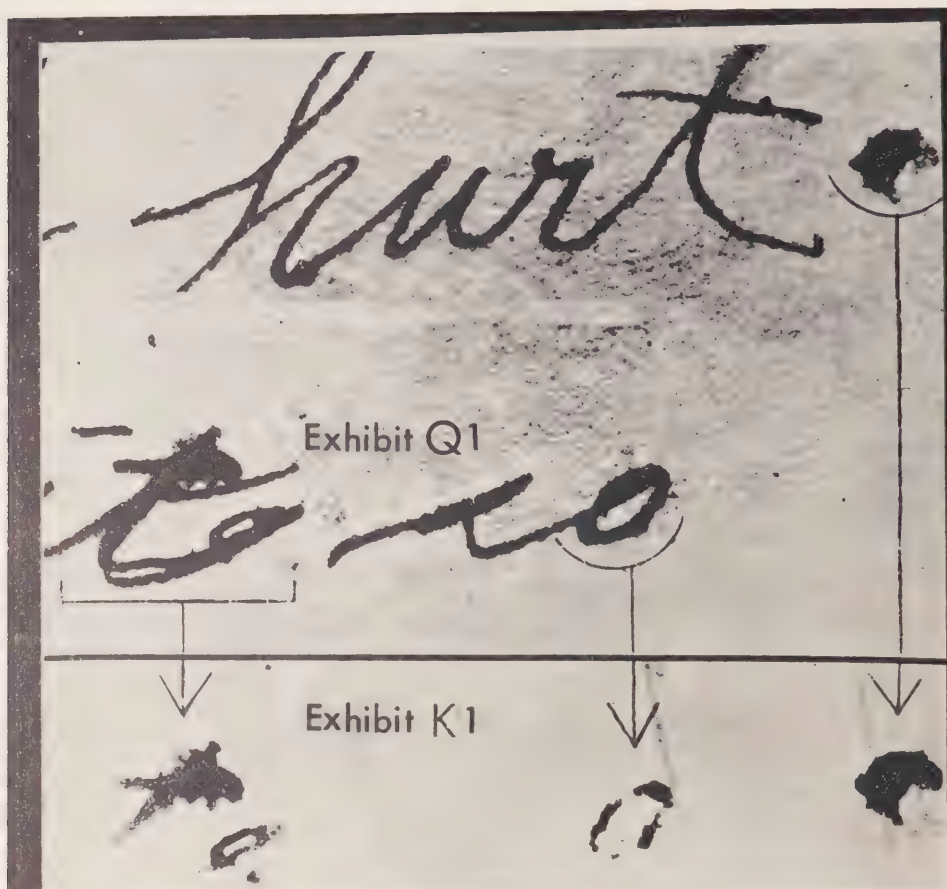




Slide No. 9



In conducting handwriting examinations it is important for the specialist to explore all aspects of a document thereby insuring essential analytical coverage and fulfilment of possible legal presentations. In the slide shown of a forged check the signature reveals an excessive and irregular deposit of ink. By employing infrared photography it was possible to penetrate the sub-surface of the writing thereby exposing the continuous outline of another writing instrument. It was established that the forger, lacking a pen, had used a pencil with a broken lead in signing the check.



Slide No. 10

When the human mind becomes temporarily imbued with the thought of acquiring financial gain by the false expediency of altering a document, the problem may require special study. This was the situation when a soldier, about a year after being discharged from the Army, incurred a head injury that proved fatal. Subsequently the mother filed a claim with the Veterans Administration alleging her son's death was traceable to a service connected head injury and submitted a letter written by him while in the army, containing the statement "I got my head hurt". As the next slide reveals, the claim was proved fraudulent when the examiner detected ink offsets on the claimant's communication which matched specific parts of the ink writing in the questionable sentence contained in the son's letter. The claim, amounting to \$30 - \$40,000, was denied.

1. A a B b C c D d E e F f Z  
 Q q R r S s T t U u V v W w X x Y y Z z

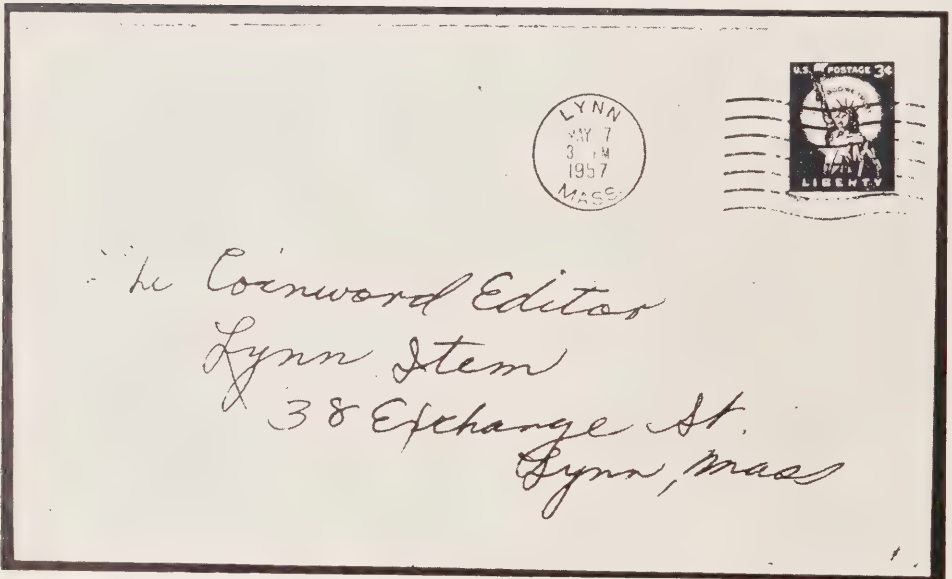
2. H h I i J j K k L l M m N n  
 O o P p Q q R r S s T t U u V v W w X x Y y Z z

3. A a B b C c D d E e F f G g H h I i J j K k L l M m N n  
 O o P p Q q R r S s T t U u V v W w X x Y y Z z

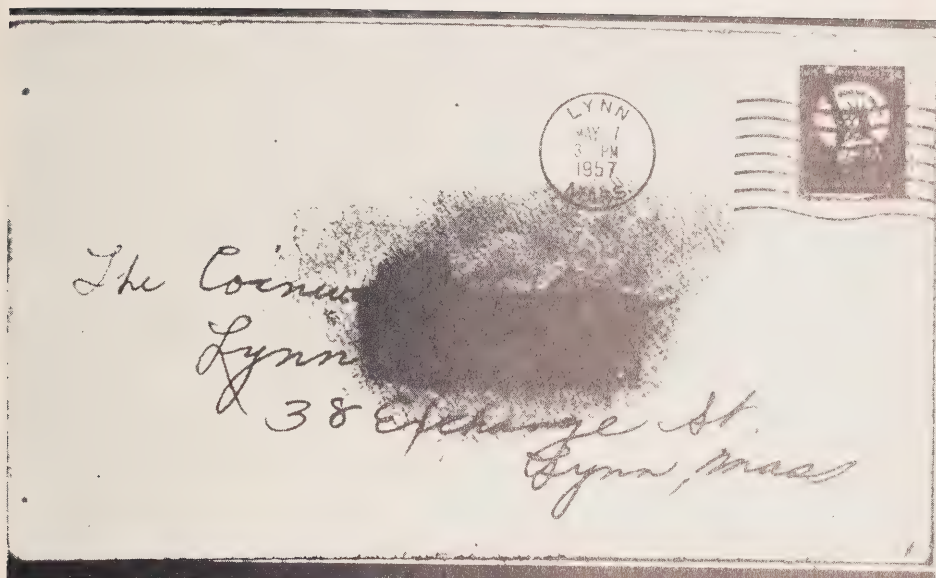
4. A a B b C c D d E e F f G g H h I i J j K k L l M m N n  
 O o P p Q q R r S s T t U u V v W w X x Y y Z z

Slide No. 11

When a 37 year old suspect denied authorship of a series of obscene letters to young girls claiming he could not write, a postal inspector prepared the alphabet on a sheet of paper and prevailed upon the suspect to copy it. Complying with this unusual request, the suspect proceeded to write each character in his own inimitable style, entirely disregarding the letter forms of the investigator, as shown in the next slide. When the jury returned a verdict of "guilty", the presiding justice commented, "This is perhaps the only way of solving a case such as this".



Slide No. 12(a)



Slide No. 12(b)

Occasionally someone attempts to win a contest by awaiting the final scores and mailing the entries in a pre-dated postmarked envelope. The first slide illustrates the face of such an envelope before laboratory tests. The succeeding slide reveals how treatment with black powder formed a dark rectangular pattern in the address area corresponding with a strip of adhesive paper tape that had obviously been affixed to the envelope addressed to the sender, removed after obtaining the pre-dated postmark shown, and re-addressing to the Contest Editor.

I am very positive in my conviction that the first responsibility of a document examiner is to conduct the examination along the lines requested by the investigating officer. Failing, however, to reach a solution the examiner has an equal responsibility to employ his acquired knowledge and experience in further pursuing the problem and offering any helpful suggestions that may contribute to its termination.



## Discussion of Mr. Somerford's paper

COLE: Mr. Somerford, I have made a number of experiments to reproduce the condition you showed there, writing with a pencil dipped in ink and I should like to point out that you do not get the effect that you showed there unless the lead is worn down to the wood, then you get both a deposit of graphite and a deposit of ink.

SOMERFORD: That is true, otherwise there would not be enough of the ink adhering to the point.

COLE: The lead itself will not carry enough ink to give you a continuous writing.

HILTON: One point of some interest on dating information of ball point pens. What Mr. Somerford said is absolutely correct, I think we are proper in using the October date (1945) as the beginning date of the availability of ball point pens. Mr. Godown and I both feel that it shifts the responsibility to prove that you had a ball point pen before that time. These pens were available in South America and I personally have had in my possession a few documents which were authentic cancelled cheques, written in June 1945 with a ball point pen that had gone through New York banks on New York bank accounts.

SOMERFORD: From South America?

HILTON: This was writing done by a man who was spending his time between Miami and New York City. The only thing I can conclude is that through someone who had been to South America, a few pens were brought back to this country, but I do not think that invalidates the other date, as the first date of general availability.

SOMERFORD: Was not this pen also developed previous to that by someone in France?

HILTON: The information I have is that it was developed in Central Europe, I believe that the patents were brought to France before the war. At any rate a very limited number of pens were manufactured in Europe prior to the outbreak of war in 1939. Bireault who held the patents ultimately went to Argentina, but I believe it was about a year and a half or so before they hit the market here.

GODOWN: In arriving at a date, have you rested solely on Mr. Hilton's article and other published material, or did you have any original research done with the manufacturers as to what was available, as of what day? Do you have any primary evidence of that date?

SOMERFORD: All my evidence came from New York City, one being of course Mr. Hilton's source and prior to that we had obtained information that Macy's or Gimbel's were distributing the Reynolds pen for the first time. We have those advertisements which date the first public appearance.

GODOWN: From the New York papers?

SOMERFORD: Yes.

HILTON: From what little I know about Reynolds, I do not think they tested their pens on the public prior to general distribution.

GODOWN: I know of an incident that would indicate that possibly there had been some pens around that were actually being tested by consumers without disclosing it.

DUXBURY: With these pens originating in France, would they be imported or would they be French manufactured, Mr. Gayet?

GAYET: They have been imported through the American troops there.

DUXBURY: From the States?

GAYET: That is right.

# Cash Register and Cash Adding Machine Identification

J. WARREN

R.C.M.P. Crime Detection Laboratory.

Regina, Sask.

Criminal investigators today are becoming more and more conscious of the assistance which may be rendered in all types of investigations by the Crime Detection Laboratory, and consequently they are becoming more dependent on the Laboratory to supply technical evidence which may prove to be a vital link in the solution of a crime. This factor, together with the never ending experimentation and research conducted in the Laboratory, has resulted in the receipt of exhibits requiring examinations and comparisons not previously performed by the various scientific sections.

The Document Section is certainly no exception to this practice as from time to time exhibits are submitted for examination which may lead the Document Examiner into a new field of endeavour requiring considerable research and experimentation.

Within the past few years there have been cases involving cash register receipts forwarded to the Regina Laboratory for examination as to possible make of machine involved and also the identification of a cash receipt to one particular cash register. Although cases of this nature cannot be classed as common, it will be appreciated that considerable time is consumed on each occasion in interviewing various cash register agents to collect information relevant to cash registers, which of course, is an absolute necessity before a satisfactory examination is permitted.

The purpose of this paper, therefore, is to briefly outline information pertinent to cash registers and cash adding machines, and by means of illustrations point out various "class" characteristics appearing on a customer's cash receipt or on an audit strip tape, which will permit the identification of a particular make, and in some cases, model of cash register or cash adding machine, by visual examination and comparison. The occurrence of certain "accidental" characteristics present on cash receipts or on the audit strip tape, making identification of an individual machine possible, will also be discussed and illustrated.

The cash register is basically a recording, calculating and checking machine which is widely used in all types of retail establishments and considered indispensable for good business management. It will be appreciated that the cash register, due to its complicated mechanism and varied operations, is a costly item and for this reason a goodly number of independent retail merchants employ the less costly cash adding machine which they simply mount on some type of cash drawer. The cash adding machine as opposed to the cash register, does not fulfil the many complicated functions required of the cash register, but simply records individual purchases and supplies a total. There is no visible indication of purchase or total for the protection of the customer, nor any safeguard against thievery for the merchant. The cash adding machine generally does not provide a customer sales receipt but simply records all transactions on the audit strip tape within the machine to assist the merchant in "cashing-out" at the end of the business day.

Since the invention of the cash register by James Ritty of Ohio, U.S.A. in 1879, numerous changes have taken place which would make that machine unrecognizable today. The cash register as we know it is a very complex mechanism operated either electrically or manually (Figure 1), which functions when keys designating cash amounts are depressed; activating certain levers, cogs, gears, pinions and finally the type wheels themselves, rotating them to their respective amounts. As these type wheels are locked into position for the amount depressed, a hammer either strikes or squeezes the paper



Figure 1

tape overlaid by an ink ribbon, against the type face thus printing the amounts on the paper tape. When a total of all purchases is desired, a rotor bar mechanism is depressed which activates a new series of gears and cogs rotating the type wheels again until the correct total is evident and the hammer strikes, recording the total on the paper tape.

The wheels of type in a cash register are telescoped so that they operate individually by means of cogs and rotate on a common shaft (Figure 2). The number of type wheels in a machine may be determined by the number of banks of visible keys. The type on the wheels is engraved and the wheels themselves may be made of either brass or a soft white metal. There are two sets of numerals "0" to "9" located on the circumference of the type wheels



in most machines, so that the customer cash receipt and the audit strip tapes may be printed simultaneously by means of individual hammers and independent ink ribbons. This method is common to the National and Sweda cash registers, but not used in the Victor McCaskey machines. The Victor-McCaskey Cash Registers utilize an emulsion type paper in their tapes which acts similar to a carbon and prints on two tapes simultaneously using only a single set of type wheels and single hammer. Their second model of cash register rather than using an emulsion type tape employs a double ribbon process which also prints two paper tapes at one time, using a single hammer and one

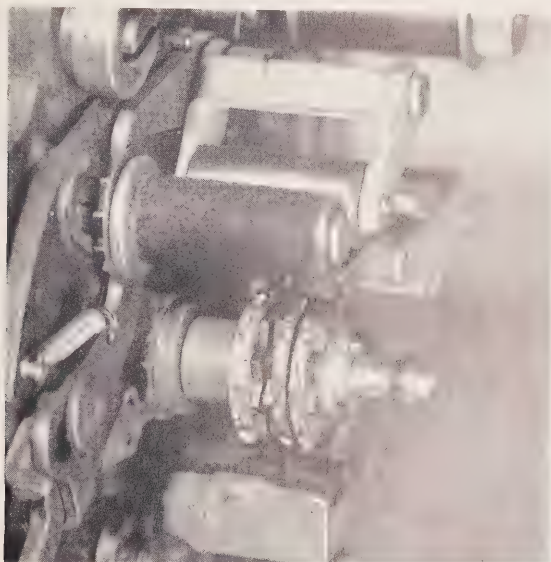


Figure 2

set of type numerals. Figure 3 illustrates the telescoped type wheels and hammer (blow) in the strike position. It will be noted that the alignment palls have not as yet engaged in the type wheel cogs and will not do so until the cam has completely depressed the hammer spring. The correct horizontal alignment of type wheels is insured by the use of these alignment palls. The palls fit into cogs or sprockets which are a part of the type wheel and when they are engaged in their cogs align the type and hold them in a fixed position until the hammer strikes. Figure 4 shows the alignment palls still engaged in their cogs immediately after the hammer has struck.

There are two types of hammers used in the various cash registers and each type may be differentiated from the other. The squeeze type hammer which operates by means of a cam and a squeeze type action, actually embosses the paper tape or receipt, while the blow hammer which operates by spring tension, does not.

Actually very little wear occurs in the cash register for a number of years if serviced properly. Most companies, with the purchase of a new machine, offer a ten year servicing period at a minimum of cost and guarantee that the machine will be serviced every three or four months each year. This service consists mainly of lubricating, changing ink ribbons and cleaning the register. Wear or damage to the type face itself is virtually non-existent, however, it can occur if a pin or staple comes in contact with the type as the hammer





Figure 3

strikes. The most common cause of type face damage is attempting to clean the type, using some sharp instrument which may scratch or gouge the soft metal type face.

In time, wear will occur at the hubs of the type wheels, due to their weight on the shaft, which may cause a slight malformation in the wheels, resulting in misalignment of type. This wear is more evident in brass type wheels than in the white metal wheels.



Figure 4

The continual striking of the hammer against the type, will, in time, produce pitting or cause depressions in the hard rubber platen. This too is stimulated by a reaction of the ink and rubber which results in rotting the rubber platen. If the hammer rubber is not replaced, and the pitting severe, one may find that the paper tape is actually perforated by the hammer action. The rubber platen of the hammer shown in Figure 5 illustrates this pitting and wear, to such a degree that paper tape perforation would certainly occur.

Springs will from time to time lose their tension and this frequently occurs in the hammer spring, resulting in a very faint impression on the paper tape. The same effect results from wear of the cam in the squeeze type hammer. Generally a faint impression on a paper tape is due to an old ink ribbon and is remedied by replacing the ribbon.

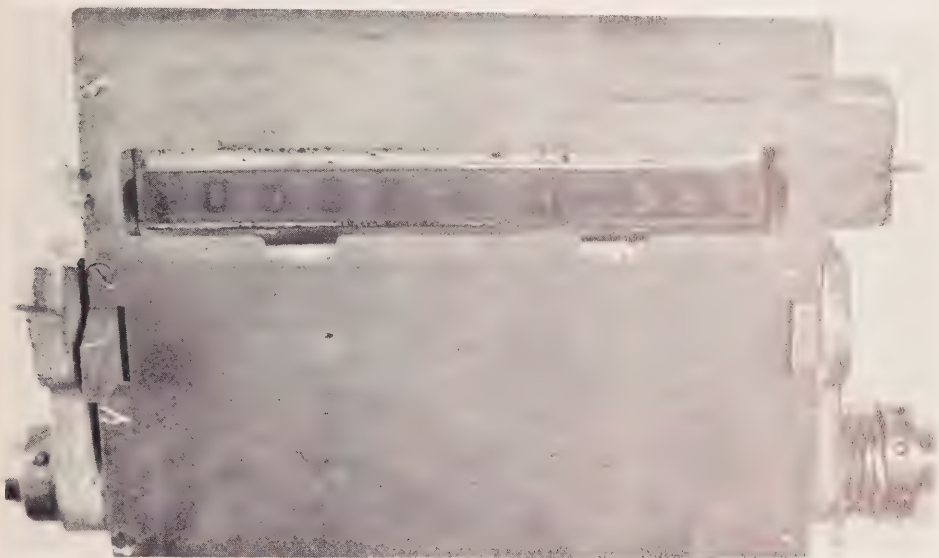


Figure 5

In the cash register, you will find a duplicity of alignment faults in the cash receipt and the audit strip tape due to the fact that both sets of type are mounted on a common type wheel. The point to keep in mind, however, is that a numeral consistently striking low on the customer cash receipt will have the exact opposite alignment position on the audit strip tape, i.e. will strike high. The vertical misalignment features will be consistent on both tapes. Quite often type wheels are replaced on older models of cash registers and as there is no method of measuring tolerances etc., of the wheel, the replacement type wheel may be slightly out in horizontal or even vertical alignment. These accidental features or characteristics of course simplify the identification of a particular cash register.

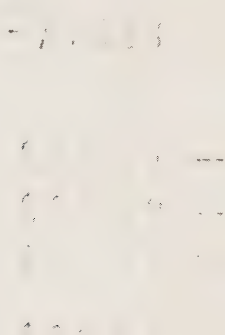
Figure 6 illustrates a customer cash receipt which bears very faint impressions. These faint impressions are due not only to an old ink ribbon in the machine, but also a weak hammer spring. This is particularly evident in the \$.03 tax on the receipt. Numerous misalignment features are also noted and in all probability are due to wear at the type wheel cogs or alignment pins.

The cash adding machine due to its limited operations is a different mechanism altogether from the cash register. The numeral types generally are

individually set out in rows within the machine and when keys are depressed a series of selectors segregate the numerals to be used which are consequently struck by a hammer which actually pushes the type against the ribbon and hence on to the paper tape. Misalignment is far more common to adding machines than cash registers as there is no means of setting the alignment. The numerous springs used throughout the machine also lose their tension in time causing extreme misalignment and a general looseness of set. The lifetime of the adding machine is relatively short as compared to the cash register.

Dealing first with Cash Registers and the identification of customer cash receipts and audit strip tapes to a particular make of machine, it should be mentioned that there are only three makes of cash registers presently used throughout Canada.

The second most widely used cash register in Canada is the Sweda, manufacturing cash registers for over 65 years and as a result this machine is encountered in the majority of business establishments. The National Cash



**Figure 6**

Register Company produces over 500 models of cash register, which are divided into various classes of machine, including the Classes 21, 51, 100, 200, 1000, 1500, 1600, 1900, 1000 and 6000.

The second most widely used cash register in Canada is the Sweda, manufactured by the Sweda Cash Register Company of Sweden. These cash registers have been manufactured since 1935 in Sweden, but were first distributed in the United States in 1947 and in Canada in 1952.

The third cash register used in Canada is the McCaskey, which at one time was an independent company, but has now been taken over by The Victor Adding Machine Company of Chicago, Illinois, and has the trade name of "Victor-McCaskey". This cash register is not nearly as common as the "National" or "Sweda", but is still found in a number of retail stores.

Over 90 per cent of all National Cash Registers carry the firm name on all customer cash receipts which makes the location of a register relatively simple. The exceptions to this practice are the very old "National" machines which are now actually obsolete, but may still be in use.

MONOCHROME  
PAINT INDUSTRIES LTD.  
550 NOTRE DAME AVE.

RECEIVED  
MAY 10 1961  
MONTREAL

|                          |       |      |   |       |
|--------------------------|-------|------|---|-------|
|                          | APR 9 | 6 26 |   | 10 35 |
| \$-006.77=D              |       |      |   | 10 35 |
| \$-000.00=D              |       |      |   | 10 35 |
| \$-000.00=D              |       |      |   | 10 35 |
| \$-000.00=D              | \$    | 8.90 | A | 10 35 |
| \$-000.00=D              | \$    | 0.00 | A | 10 35 |
| \$-000.00=D              | \$    | 4.56 | A | 10 35 |
| \$-000.00=D              | \$    | 3.45 | A | 10 35 |
| APR 10 3 71 *\$-006.77=D | \$    | 1.01 | A | 10 35 |

THANK YOU

THANK YOU

Figure 7

"Sweda" cash registers print the firm name on all customer receipts. "Victor-McCaskey" register turns out a receipt very similar to a cash adding machine, in that they do not carry a firm name or a consecutive number.

Figure 7 illustrates three types of customer cash receipts printed by different classes of National Cash Register. These receipts have certain "class" characteristics which will readily identify them as being from a National Cash Register. Examination of these customer receipts shows the following main points of identification:—

- (1) Serrated edges at the top and the bottom of the receipts are torn off in all makes of National Cash Register;
- (2) The receipts carry the firm name;
- (3) The receipts are dated—in some "National" models the date is stamped on its side;
- (4) The receipts bear a consecutive number—operating as an activity counter—denoting the number of cash customer sales in any one day;
- (5) The total is shown at the bottom of all receipts;
- (6) The receipts will show evidence of either "blow" or "hammer" marks.

The audit strip tape of the "National" will bear the letter "Z" each time the register has been "zeroed" and the letter "X" or "TL" for total.



shown at top 2.

|        |      |           |             |
|--------|------|-----------|-------------|
|        |      | 1         | 0.00262 1/2 |
|        |      | 1         | 0.00050     |
|        |      | 1         | 0.00067     |
|        |      | 1         | 0.00073     |
|        |      | 1         | 0.00067     |
|        | Gr★  | 0.000.56  |             |
|        | Hi★  | 0.000.70  |             |
|        | Pr★  | 0.000.80  |             |
|        | Tx★  | 0.000.70  |             |
|        | •★   | 0.00276 T |             |
| FEB-73 | 0021 |           |             |

5935 155555

THANK YOU  
CALL AGAIN

Figure 8

Figure 8 illustrates two customer cash receipts issued by a Sweda Cash Register. These receipts typify the two basic models of cash register manufactured by this Company. The model "46" commonly called the "narrow printer", and the model "76" or the "wide printer". All models of the "Sweda" use a similar style of type which will vary only as to size. Outstanding "class" characteristics which will readily identify these receipts as having been produced by a Sweda Cash Register, are as follows:—

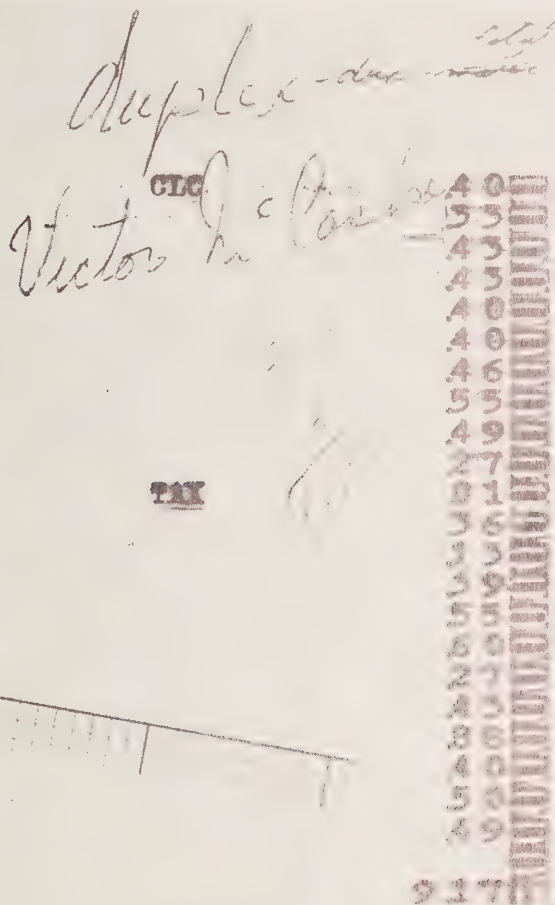
- (1) Straight edges at the top and bottom of the receipt—all "Sweda" receipts are cut by means of a knife within the machine.
- (2) All the receipts carry the firm name;
- (3) All the receipts are dated—the date is upright in a model "46", however the year date is always on its side in a model "76";
- (4) The receipts bear consecutive numbers indicating the number of cash sales per day;
- (5) All totals in a model "46", narrow printer, are shown at the top of the customer receipt—all totals are shown at the bottom of the receipt in a model "76", wide printer;
- (6) The type style is consistent in all models of Sweda Cash Registers.

The audit strip tape on the Sweda Cash Registers bear the date and also the consecutive number. All items are recorded on the audit strip and are preceded by a star and type of sale, i.e.; Gr (groceries), Pr (produce), Tx (tax). Totals are preceded by a period and a star.

Figure 9 shows two customer cash receipts from the two models of Victor-McCaskey Cash Registers. These receipts are easily identified from the other two makes of cash register receipts, mainly because the receipts resemble a cash adding machine receipt. Examination of the illustrated receipts will

(1) Serrated edges at the top and the bottom of the receipt—all receipts are torn off by the operator.

(3) The receipts do not bear the date nor consecutive number:



(4) The type style is consistent on all models of V1000-MC68000. Registers;

(6) The Dual-Total model uses a double ribbon for printing on both sides of the receipt and audit strip tape simultaneously using one hammer only—there will be a noticeable ink off-set on the reverse side of the receipt.

The audit strip tape in the Victor-McCaskey Cash Register will be identical to the customer receipt in that they are printed simultaneously utilizing the same numeral type and hammer.

The problem of identification of any customer cash receipt or audit strip tape as to the probable make and in some cases, model of cash register which produced it, should be readily ascertained if the various "class" characteristics as listed herein for the three makes of cash registers, are perused and questioned receipts compared with the illustrated receipts.

There are numerous cash adding machines and calculators manufactured by various companies throughout Canada, however, western distributors are limited and as a result only the major companies have offices in Western Canada. These major companies were visited and the following information gained. The problem of identification of cash adding machines and calculators is simplified by the fact that all of the various manufacturers utilize one particular style of type, peculiar to their machines. Not only do type styles vary with the various

|              |                | Symbols:    |
|--------------|----------------|-------------|
| R.C. ALLEN   | 1234567890 * < |             |
| BURROUGHS    | 1234567890 * ① |             |
| CLARY        | 1234567890 T   |             |
| McCASKEY     | 1234567890 T ② |             |
| REMINGTON    | 1234567890 * ③ |             |
| SMITH-CORONA | 1234567890 I C |             |
| UNDERWOOD    | 1234567890 □   |             |
|              |                | total clear |

Figure 10

makes of adding machines and calculators, but different symbols are used to denote "totals" and "zeroing out" or "clearing" of machines. A chart was prepared depicting the type styles of the various companies manufacturing cash adding machines and calculators and also the various symbols used on the respective receipts. The numerals on the chart were taken from numerous receipts of each model of adding machine or calculator, and were photographically enlarged two diameters to permit easier comparison. Each manufacturer utilizes one consistent style of type, however, the size of type may vary with certain models. Figure 10 shows a comparison chart for the identification of cash adding machines and calculators.

The proposed procedure sets out an orderly method for rapidly identifying the make, and in some cases the model, of a cash register, cash adding machine

or calculator used in the production of a questioned customer cash receipt or audit strip tape. A limited group of cash adding machine manufacturers have been included, but these represent the vast majority of cash adding machines encountered in this country today. The system has flexibility so that additional cash adding machines may be incorporated, if desired, and the chart expanded to include any new machines outside of the present study. Constant use of this method, when required in an examination dealing with cash register and cash adding machine customer cash receipt or audit tape identification, should lead to an appreciable saving in time by the document examiners.

### Discussion of Mr. Warren's paper

HILTON: Have you had any opportunity to check whether there had been type design changes in past years on any of either the cash adding machines or the registers?

WARREN: No. I made rather a broad statement saying that the styles are consistent but having read your article in the Scientific Examination of Documents, pertaining to cash adding machines, I noticed that the McCaskey adding machine had changed style over the years. I was limited strictly to the dealers as sources of information which is not too satisfactory.

HILTON: One point that I had discovered some time ago on the adding machine which I presume is the basic instrument to these cash adding machines and that is that some of the manufacturers do space their type differently across the columns. Some are spread out more than others and where you have an actual tape to look at the spacing is a very quick way that you can recognize some of the adding machines. I do not think it is necessary with cash registers, you do not have enough different kinds, and they seem quite distinctive.

WARREN: In talking to numerous repairmen, they said it is extremely hard to position a replacement type wheel exactly the same as the manufacturer. There is no set way to measure tolerances and sometimes they may be out just a shade, but they are out.

HEADRICK: You mentioned the N.C.R. papers or process. Have you attempted to determine just what chemicals are used in that paper?

WARREN: No, I have not.

GODOWN: There have been several discussions of what that N.C.R. paper is which have been the basis for the patents. It is being used extensively for other records that you might encounter such as Pullman reservations. Most of the U.S. railroads are now using it as a common ticket for any railroad or any Pullman. It is a rupture of a wax coating in the surface which will let chemicals together from the back of the original and the face of the copy.

HILTON: One more point on the N.C.R. paper, quite by chance I had a sample of it several years ago laying on my desk half covered and half uncovered and I discovered that light does affect it. It changes colour where it is exposed to daylight for a long period of time.

GODOWN: As to changes in some of the type used by manufacturers of adding machines there have indeed been changes and there are many places for dating information. I do know that the Clarey people made a change in type because I have had occasion to look into it. I would also like to comment that most of the identifying characteristics of some of these makes of adding



machines you are likely to find on a cash drawer, because it is usually a simple conversion from one to the other for most of the companies. Incidentally, there are 30 to 40 makes of adding machines being sold in the United States. The position of the decimal point with respect to the type is sometimes of interest. Some machines place the decimal point on the type segment of the tens or ten cent column and others will place it at the rear of the dollar column type which is sometimes helpful in classifying adding machine tapes. Another thing to note is whether or not ciphers appear when the machine is clear regardless of whether you are putting any figures in the machines at all or not. In some cases they will automatically print the decimal point and two ciphers everytime you pull the handle while other machines make no print at all at that time. This may identify the mechanism of the machine. Several different things are important with respect to the method of printing. Some of them use a squeeze, some of them use hammers, some of them have individual type for each numeral in each column, others have a type bar that represents the entire series of numbers in a column and some have type wheels. You have to find out what machine you have and what principle it follows before you can get down to individual identifying characteristics.

# A Review of the Printing and Duplicating Processes

A. M. HEADRICK

R.C.M.P. Crime Detection Laboratory

Sackville, N.B.

Although handwriting comparisons constitute the bulk of the work of the document examiner, he is also called upon to make a certain number of examinations and comparisons touching a wide variety of fields of human endeavour, and included in these are the fields of engraving, printing and duplication.

In this connection the examiner may be called upon to examine certain documents to determine the type of printing or duplicating process used to produce text or material thereon; or to determine the particular printing or duplicating machine used to produce such material. He may be asked to examine a number of documents to determine if, in each instance, the same printing plate, type, master, stencil or original text was used. Occasionally he may examine the printing plate, master, stencil, etc., in an attempt to determine the type of printing press or duplicator with which they would normally be used, or the particular press or duplicator on which they have actually been used. Finally he may attempt to determine the methods or apparatus used in the production of such plates, etc.

Such examinations have been required during investigations involving the counterfeiting of currency and postage stamps, and the complete forgery of important or valuable documents such as immigration visas and bingo cards, or forms such as invoices, letterheads and price lists in cases of fraud and illegal combine practices of manufacturing and outlet concerns.

There is some reason to believe that such examinations will increase in number as technical knowledge of the graphic arts becomes more commonplace and machines are perfected that will reproduce or duplicate material with extreme precision.

In many cases an examination of material connected with these fields will permit no conclusion, or an indefinite type of conclusion. It is apparent, however, that complete and satisfactory examinations cannot be made by a document examiner has at least some general knowledge of the printing and duplicating machines and processes.

It is hoped that this paper will provide some assistance to those who wish to obtain a desired knowledge and background in these fields. There are undoubtedly many of you who already know more than this paper can offer and to those I can only plead the difficulty of covering completely such broad and highly complex subjects. This paper highlights some of the information that has been brought to my attention while working on document problems. Owing to the rapidity of innovations and improvements in the processes, techniques and the apparatus used, particularly in the duplicating field, some of the contained information may be already outdated and therefore incorrect.

To facilitate the presentation of this paper, it will be given under several general headings; "Types of Printing Machines", "Kinds of Printing Processes", "Copy", "Typography", "Plate Making", "Duplicate Plates" and "Duplicating Processes". The material under each of these headings must be somewhat repetitive, however, and this has led to some repetition.

## ***Types of Printing Machines***

All printing machines can be roughly classified into one of three types (1) Platen Presses (2) Flat Bed Cylinder Presses and (3) Rotary Presses.

*The Platen Press* consists of two flat beds, one called the press bed which holds the printing type or plate, and the other called the tympan which holds the paper receiving the printed impression. The two beds usually come together with a clam-shell movement, but some close with a movement perpendicular to the faces of the platens, as in the small hand press. Since enormous pressure is required for simultaneous printing of the flat surfaces, it is impractical for platen presses to be made in large sizes.

*The Flat Bed Cylinder Press* consists of a bed, holding the printing surface and which runs back and forth or up and down, and one, two or possibly more, impression cylinders, which presses the paper onto the printing surface and which revolve in unison with the movement of the bed. These presses are faster than platen presses and are noted for their flexibility and adaptability to various printing requirements. There are three types (a) the Drum Cylinder (b) the Stop Cylinder and (c) the Two Revolution Cylinder.

The Drum Cylinder makes one revolution for each impression. One half of the cylinder has a smaller radius than the other. That half of larger radius is the impression surface and presses the paper against the printing surface. The half of smaller radius allows for the return of the bed thus eliminating the necessity of raising the cylinder. The printed sheet is taken off and a blank sheet is taken on during each revolution, and the drum revolves continuously, being geared to the bed.

The Stop Cylinder has a smaller cylinder and three quarters of its circumference is used for the impression. The other quarter of the circumference is flat or of smaller radius to allow for the return of the bed. The cylinder is geared to the bed by ratchets which stop the cylinder when the bed returns. The printed sheet is taken off, and the blank sheet is taken on when the cylinder is stopped. The vertical job press is a variation of the stop cylinder press, wherein the bed is vertical and stationary, and the cylinder moves up and down. The Koenig machine is also a variation of the cylinder, having a rocking motion. It makes one revolution, then raises and reverses its motion on the return of the bed.

The Two Revolution machine is a standard type for general work. A sheet is printed in one revolution of the cylinder. The cylinder then rises to allow return of the carriage and makes another revolution in the same direction as the first to discharge the printed sheet. The cylinder is not actuated by the bed but driven independently in unison with the bed. The inking is on the slab principle, i.e. the ink is placed and spread on an ink plate by two or more distributing rollers. This ink is then transferred from the plate to the forme on the bed by forme rollers.

All cylinder presses and especially the Two Revolution machines may have two cylinders either to print two colors, one right after the other, or to do perfecting work (i.e. print two sides of the sheet of paper).

*Rotary Presses* consist fundamentally of two cylinders, one the plate cylinder carrying the plate, and the other, the impression cylinder, pressing the paper onto the plate. In offset machines a third cylinder is added with a rubber blanket and this is called the offset cylinder. This cylinder takes the impression from the plate, then transfers it to the paper.

The plate cylinder either has the printing surface engraved or etched into it or has a thin plate wrapped around it which bears the printing surface. Because of their speed the paper must be fed automatically and this can either

be "sheet fed" or "reel fed" (sometimes called "web fed"). Multi-color machines either consist of one large impression cylinder surrounded by four separate plate cylinders each with its own inking mechanism, or they may consist of banks of separate plate and impression rollers each printing a single primary color.

Newspresses are reel fed rotaries built into units according to the number of pages needed and all are perfecting. These machines are capable of producing 45,000 copies per hour and the paper is fed at a speed of 54 miles per hour. Because both the forme and the printing surface are cylinders it is necessary to curve the type and illustrations. This is done in the case of newspaper machines by casting a curved stereotype out of metal. Most other jobs are done with curved electrotypes. Sheet fed presses are not limited in relative size of plate to paper in order to eliminate waste, but are slower than web fed presses. Speed and quality do not usually go together.

Richard Hoe invented the rotary press in 1846.

### ***Kinds of Printing Processes***

Printing methods are generally classified into four different categories, depending on the type of plate used. These are:

(1) *Letterpress*—also known as relief printing. The printing portions of the plate or type are raised above or protrude from the surface. This includes multigraphing, addressographing and rubber stamping.

(2) *Planographic*—uses a plate that is flat or relatively flat. Most planographic processes use a grease type ink and operates on the principle that grease and water will not mix. The surface of the plate is treated in such a manner that the printing surfaces repel water and promote attachment to grease, while the non-printing areas of the plate collect water and repel grease. This process includes lithography, offset lithography, photolithography, photo gelatine process, dual metal processes, small office machines such as Multilith, Davidson and Rotaprint.

(3) *Intaglio*—the printing areas are cut or etched into the surface of the plate. The ink is squeezed into these recesses and the surface is then wiped clean. This process includes copper plate engraving, steel plate and die engraving, photogravure and rotogravure.

(4) *Stencil*—the printing areas are cut or treated so that ink can be forced through the stencil. The non printing areas consists of some material which resists the passage of the ink. This includes silk screen printing, stencil duplicating and addressing.

With the exception of the stencil process, each of the above processes will be considered in greater detail.

*Letterpress Printing*—The first presses were made of wood and operated on the screw principle. The next were made of iron and operated by a series of compound levers. There are two main operations in this type of printing:— (1) Setting up of type, reading, making up the type and blocks into pages, imposition and locking up. All this work is done by the composer and in the composing room. (2) Printing, fixing the forme on the machine, making ready (a process whereby irregularities of pressure are removed), getting position on the sheet, inking and the actual printing. This is considered the work of the pressman.

The use of letterpress printing is indicated where the run is short and the material is mostly type and rule. Large illustrations can be printed but the cost of the plate is high. It has an edge in quality in printing type and can produce fine, clear, sharp halftones and good color areas.



The basis of letterpress printing is type, but illustrations made by line and halftone engravings, woodcuts, wax engravings, chalk plates, plates cut by the Scan-A-Graver, Clichchograph, Elgrama and Luxograph machines are commonly used. Most of the letterpress work is done from duplicate plates rather than the original type or engravings.

*Planographic*—The lithographic process originally made use of Bavarian Limestone and was first used in 1796 by Alois Senefelder. Lithography literally means stone writing. When the ink is transferred direct to the paper from the stone or plate it is known as lithography. If the inked image is first transferred to a rubber blanket and then onto the paper it is known as offset lithography.

Zinc and aluminum plates have now replaced the stone, and rotary presses have largely replaced the old hand presses and cylinder presses.

The plates can be drawn on directly by hand, processed by using a special transfer paper which is drawn on or received its impression from another plate, processed by Photo Offset or Photolith, made by the Deep Etch process, or a number of other ways. The hand drawn plates are invariably line engravings but the Photo Offset and Deep Etch can be either line engraving or screened halftones.

Offset Lithography is widely used because fine detail is possible on rough paper, there is low cost on long runs and for extra large color or illustration areas, and it is easy to prepare repeat jobs. The offset process may reduce the sharpness of the lines produced.

*Intaglio Process*—Steel and Copper Plates are used for business and calling cards, bank notes, bonds, stock certificates, stamps and letterheads. Heavy deposits of ink are transferred which are apparent to touch. The edges of the ink line are extremely sharp. The original plate is expensive and the presses used quite slow. Duplicate plates can be made by Transfer presses.

Photogravure is continuous tone, screenless gravure printing. These plates can be used with rotary presses but are chiefly used in smaller hand or sheet fed presses.

Rotogravure produces variation in tone by varying the ink film thickness instead of the dot size as in halftone. The ink used is slightly transparent. It is liquid and oily, tending to spread soon after the printing, thus lessening the visibility of the cell walls. Because tones are reproduced by variances in density of the ink film, there is a characteristic luminosity to the reproduction. This gives fine reproductions of photographs, watercolors and wash drawings. There is difficulty in reproducing fine line drawings and type by this process. The printing surface is engraved into the copper cylinder itself and this is used usually in web fed machines.

Sheet fed gravure is fundamentally the same as Rotogravure except the printing surface is engraved into a thin copper sheet that is wrapped around a cylinder and the paper is fed in sheets instead of reels. It is cleaned with a doctor blade as in Rotogravure. Because of the sheet feed it is relatively slow but the plates are quite inexpensive and there is little waste in paper.

Rotary Photogravure has been used by calico, wallpaper and linoleum manufacturers since 1858.

The Intaglio process is imitated by Thermography. This printing is made by ordinary letterpress and while the ink is still wet a special powder is sprinkled on it which is then baked and fused.

Other intaglio processes in which the plate is usually made and inked by hand and used on a hand press are Drypoint Etchings and Mezzotints.

## Copy

"Copy" in printing is that which is to be reproduced. This may be derived from a mind picture, a verbal description, manuscript, rough pencil sketch or drawing, pen drawing, wash drawing, a photograph, a crayon drawing, a print from a halftone or other engraving, a painting or an original article.

The copy may be (a) cut into the plate directly by hand or by machine, (b) be partly cut and partly etched onto the plate, (c) be drawn directly onto the plate then etched, (d) placed on the plate photographically (the photograph being taken of an original article or a reproduction) then etched, (e) be produced on the plate by a transfer method as in lithography or by the transfer press as in intaglio printing (f) be produced on the plate by an offset method or (g) be reproduced by plates in the letterpress process.

Some methods of producing copy (mainly illustration) are:

(1) Pen Drawings—a negative of the original subject is printed on a special silver print paper. The artist then follows the outlines of the print with pen and waterproof ink, making line or stipple shadings where needed. The composite is then bleached in potassium cyanide and washed. The print disappears leaving the lines which can be printed by the line etching process. This process can also be used in conjunction with wash drawing or other methods.

(2) Ross Paper—paper having a surface of lines or stipples etc. are drawn upon with pencil or crayon. This gives shaded surfaces similar to that of the shading machine (Ben Day screen) which are suitable for use in the line etching process.

(3) Scratchboard—a black coating over a white base is drawn on and then this finish is scratched off for special shading effects. This is then photographed and processed by line etching. Gives a finished product very similar to a genuine woodcut.

(4) The Air Brush—a special spraying apparatus which produces a small fine spray of ink. Used for obtaining color and shadings on flat surfaces and is aided in making sharp outlines by the use of masking. Printed by the halftone process.

(5) The Shading Machine—an apparatus to assist in the use of Ben Day screens. These screens have special engraved or indented surfaces on them. They are first inked, then placed on the plate or the print being copied. It is preferable to use the screen directly on the plate, using an ink resist. If they are used on the print a black India ink is used. After the screen has been selected and inked the plate or print is masked off so that only those portions exposed will receive the ink. The plate is then made with the line etching process and is good for printing illustrations on rough or cheap grades of paper. These screens are used frequently in line color plates.

(6) Washdrawing—color is applied as a wash usually with a sable brush. It is usually combined with a line drawing and used to advertise clothing, glass and machines, etc. Used instead of photographs to emphasize desirable features, but are generally copied from a photo. Sometimes a light print is made from a negative which is entirely washed or drawn over. Printed by the halftone process.

(7) Craftint—illustration board for producing line drawings. It has diagonal lines in both directions which can be made visible by the application of different chemicals for each diagonal.

(8) Shading Sheets—produce effects almost identical to that produced by Ben Day screens. The shading sheet is transparent except for screen patterns printed on it. These sheets have a wax base and are placed on the surface of the line drawing and photographed.

Line drawings generally consist of lines or stipples made with pencil, crayon, brush, pen and ink, shading machine, Rossboard, coarse spatter work, proof of type matter, typewriting, longhand, etc. There is no continuous tone and shading is effected by the spacing and size of the dots or lines.

## Typography

Typography is the art of selecting typefaces and arranging them into a desired effect. Type may be grouped into seven main styles (1) Old style types (2) Modern types (3) Sans serif (4) Monotone and Semi-monotone (5) Script (6) Black letter and (7) Decorative type. In addition to variations in designs, type also varies in thickness of letter or weights. Thus there are types that are light, normal, medium, bold and extra bold. Most of the popular heading types are available in more than one weight. Another variation in type is in the width of letters. Some families of type are available in more than one, and these are given adjectives such as regular, condensed, extra condensed and extended. In addition, most regular types are cast in a number of different point sizes. The 5 to 14 point are known as body or text types, 9 point being the normal. There are 72 points in one inch, and almost all type is set on a block at a height of .918 inch. 12 points equals 1 pica and one square pica is usually called an "em". In designing type round letters must be made larger than square ones and the lower case "t" must be made vertical or it will appear to lean back. Type metal is an alloy of lead, antimony, tin and brass.

Type is either foundry type, machine type or display type.

*Foundry Type*—the typefounder supplies type to the printer in founts and each letter is cast separately. The type is kept in lays (trays  $32\frac{1}{2} \times 14\frac{1}{2}$ ") or Compositor's job cases. It is picked from the lays and put on a composing stick (a narrow metal tray about  $10 \times 2$ " with flanges on back and right side and an adjustable slide on the left to control length of work). Spacers are placed between the words thereby justifying the lines. The work is then transferred from the stick to the "galley". When the galley is full, proofs are taken. The type is then locked up in the "chase", by a system of wedges known as "quoins". The finished assembly is known as the "forme".

*Machine Type*—produced by two types of composing machines. (1) Those which cast a "slug" or line of type as with the Linotype, Intertype, Linograph and Typograph; (2) those which produce a justified line of single type such as the Monotype.

The Linotype was invented by Ottmar Mergenthaler between 1854 and 1899. By pressing keys on the keyboard the matrixs and double wedge spacebands are lined up in front of a moulding device. The pulling of a lever causes the spacebands to be pushed up through the matrixs spreading them out to the full measure of the line. Molten metal is then forced against the matrixs and the slug is formed.

The Intertype and Linograph are fundamentally the same as the Linotype but each have special improvements for greater flexibility. The Typograph also operates in a similar manner except that the line is justified by means of circular space disks which expand as they revolve, spreading the matrixs prior to casting.

The Monotype consists of two machines, a keyboard and a caster. The keyboard punches holes in a strip of paper when the keys are depressed. At the end of each line a pointer indicates what special keys should be touched in order to ensure justification. The casting machine contains a metal pot, a mould and a matrix holder called the "die Case". The latter usually contains 225 matrixs arranged in 15 rows of 15 in a 3 inch square. The perforations in the paper control the matrixs above the mould so that they will be made in



the order desired with the proper spacing between the words. As each letter is made separately, correction or changes can be made one letter at a time, which is an advantage.

*Display Type*—This is type, usually larger than 72 points, used for newspaper headlines, posters, books, etc. It is usually engraved in wooden or brass blocks or cast on an All-Purpose Linotype or a Ludlow Typecaster. When using the Ludlow or All-Purpose Linotype systems the matrices are set up by hand on a special composing stick. These are then put into the machine which makes the slugs by casting metal into them. These machines can be set up to 144 points.

Johann Gutenberg is accredited with the invention of movable type around 1450. The first book printed from movable type was "The Gutenberg Bible".

15th Century Europe began to use movable type for books mainly because of the pioneering work of Gutenberg in Germany and Caxton in England.

## **Plate Making**

Printing plates are either (1) line engraved or etched (2) produced by the halftone process (3) screenless. Halftone plates are invariably produced by the photo-mechanical process while line plates can also be produced by hand or mechanical engraving.

The simplest and least expensive method of making printing plates is by the photo-mechanical process. The birth of photo-mechanical engraving, including line etchings, halftones, and photo-lithography dated from the application of a discovery by Fox Talbert in 1852, that a solution of organic matter such as gelatine or albumin, in which certain chromate or bichromate salts have been dissolved will, after drying and subsequent exposure to light, become insoluble in water.

Today these coatings are made by adding ammonium or potassium bichromate salts to albumin, gelatine or glue and developed in water, or to shellac and developed in alcohol.

### *1A—Line Plates—Hand or Mechanical Engraved*

These include Woodcuts, Wax Engraving, Chalk Plates, Copper and Steel Plates and Dies, Mezzotints.

Wood cuts—Boxwood, sycamore, pear, persimmon, and dogwood are usually used if it is to be "end engraved", that is, engraved at the end of the grain. Basewood or soft pine is used if engraved at the side of the grain. The design to be reproduced is first drawn or traced on the block or the block is coated with a sensitized emulsion and printed on using a negative. The block is then engraved by hand, or possible with machine, and the shading is produced by dots or lines. The larger shaded areas are usually cut with a ruling machine cutting straight or waved lines or circles. These wooden blocks are usually not printed directly but an electrotpe is made by the wax moulding process.

Wax Engraving—used to obtain extreme accuracy for such things as maps, charts, mechanical views, etc. A thin copper plate is coated with wax. A design is drawn or photographed onto this then engraved through the wax to the plate by hand. An electrotpe is then made of the finished engraving which is used directly for the printing.

When this method is used to produce a letterhead, business card, etc. with a fine script and shaded letters it is given a trade name of "Cerotype".

Chalk Plates—a flat steel plate is covered with a soft heat-proof chalk composition. This is engraved with special tools then filled with type metal



Copper and Steel Plates and Dies—These are either engravings or etchings. For engravings the text is cut into the bare metal, in reverse, either by hand or with an engraving machine. For etchings the design is cut by hand or by machine through an acid resist such as wax and then etched into the metal with acid. To produce some pictorial subjects the print of a line negative is put on the acid resist. This print is then cut out by hand, then etched with acid. A halftone negative can also be printed over the line etching to produce shading.

Dies can also be made out of steel plates. These are the same as steel plate engravings or etchings except that the cut or bite is deeper and they are printed with greater pressure. This causes extreme indentation on the back of the paper which accounts for most of the embossing on the face.

The copper plate may be nickle plated for longer runs or when printing in color as colored ink severely attacks copper.

Duplicate plates can be made from the steel plates by using transfer presses.

When printing, the paper or makeready is placed on a D-roll or tympan to assist in pushing the paper up into the engraved lines to extract the ink.

Mezzotints or Aquatints are made from plates that are roughened with a tool then scraped or burnished for highlights.

### *1B—Line Plates Engraved Photomechanically*

These include Line Etchings, Line Color Plates, and Pantones. A line negative is taken of the subject or copy and placed on a sensitized sheet of copper or zinc. After development and washing bites are taken with acid using dragon's blood or other resist to keep the acid from spreading the lines or undercutting. Copper is used when the lines are very fine.

Line Color Plates are used for printing designs on rough cover paper and primarily used on cheaper grades of paper but may be used on good grades also for special effects. The original drawing is not made in color and is made in outline only. Only one negative is taken which is used to make each of the separate plates for each color. If more than 4 or 5 colors are used in the printing it is usually more practical to use another process. Ben Day or similar screen are commonly used for tints and to produce secondary colors. The lines or screened areas may be superimposed in printing or separate shaded areas may be produced or separate flat colored areas may be produced. It is well to remember that not all dot reproductions are made from a halftone process.

Pantone is a dual metal process. In one method a copper sheet with a thin plate of chromium is covered with a light sensitive glue and developed through a negative. The non-printing areas wash out with warm water exposing the chromium. It is then etched, dissolving the chromium, and exposing the copper. Silver is then deposited on the exposed copper then all the glue is cleared from the plate and mercury is rubbed on it amalgamating with the silver. Ink will adhere to the chromium but not the mercury-silver amalgam. Another process uses stainless steel, bare in non-printing areas and oxidized in printing areas.

These methods do not require dampening rollers.

### *2—Halftone and Screen Plates*

These include Halftone Letterpress Plates, Halftone Lithographic Plates, Rotogravure and Sheet Fed Gravure Plates, Phototones, Lithotones, Phototypes, Aquatones and Halftone Color Plates.

#### *2A—Halftone Letterpress Plates*

The halftone process was invented by Frederick Eugene Ives in 1886 and came into general use about 1890. A halftone screen is placed between  $\frac{1}{4}$  and  $\frac{1}{2}$  inch in front of the film in the camera and a negative is taken of the toned

copy. All but a tiny area of the emulsion is affected by the light in the highlights. The dots are round because each aperture in the screen acts as a pinhole lens, thus the image of the round camera lens is taken on the film. The negative is then placed on a metal plate coated with a sensitized material and a strong light is placed over this which hardens the light struck areas. The plate is washed in warm water which dissolves the unhardened coating. It is then heated and dried, then etched with acid.

When dealing with letterpress halftones, especially those in newspapers, it must be remembered that they may not have been made photographically, but may have been made by electronic plate cutting machines. The most popular of these, in Canada, are the Scan-A-Graver, Scan-A-Sizer and the Clichograph.

The Clichograph is a German machine. A dull non-transparent blue colored celluloid plate and the original copy is put on an oscillating board. As this board moves back and forth, a photo-electric cell scanning the copy picks up the density and regulates the thrust of a vibrating needle scanning the celluloid plate. The vibrating needle is used cold and some machines are used to produce aluminum plates. The impressions are usually somewhat sharper than those produced by the Scan-A-Graver. It should be possible, by examining the middle tones of a reproduction to determine if it is an ordinary halftone or produced by this method. The dots in the halftone should be symmetrical while those from the Clichograph will have one angled side and one curved side. A needle lasts one day.

The Scan-A-Graver and Scan-A-Sizer are distributed by Fairchild in Toronto. They operate similar to the Clichograph except the copy and plate are put on rotating cylinders. The needle is used red hot and lasts for about 6 plates or 2 hours. The plate is blue celluloid but quite transparent and the dots are approximately 65 per inch. The dots in the shaded areas should be elongated in a direction parallel to one of the sides of the reproduction. The Scan-A-Sizer permits enlarging or reducing from the copy to the plate.

## *2B—Halftone Lithographic Plates*

The ordinary Photo Offset plate is made the same way as the Letterpress plate with two exceptions. The Photo Offset plate is a very thin zinc, aluminum or paper sheet and before the plate is washed in warm water it is placed in a special developing ink. Those areas which were light hardened retain both the albumin and ink. When the plate is on the press and bare portions accept only water, while the ink-albumin portions accept only ink. Deep etch plates are made from positives instead of negatives so that the printing areas are washed away in the bath. The plates are then given a slight acid etch causing depressions in the printing areas which are filled in with a special developing ink. The light hardened coating or non printing areas are then scrubbed leaving the bare metal. An ordinary Photo Offset plate is slightly similar to letterpress plate while a Deep Etch plate is slightly similar to intaglio plates.

## *2C—Rotogravure and Sheet Fed Gravure Plates*

To make a Rotogravure plate a positive transparency of the copy is made. A negative of a ruled screen is placed over a sheet of carbon tissue having a coating of bichromated gelatin. On exposure, light strikes through the ruling and areas behind the rules are hardened while areas between the rules are unhardened. Then the positive transparency of the copy is placed over the tissue and re-developed. This gives varying hardness to different areas between the cell walls. The tissue is then placed face down on the copper cylinder and the backing and undeveloped gelatin removed. The cylinder is then etched with acid which penetrates the gelatin.

Sheet Fed Gravure Plates are made in exactly the same way except the copy is not etched into the cylinder but on a thin copper sheet that is wrapped around the cylinder.

Phototones—these are halftones letterpress plates in which, by using a special attachment on the camera, the points and depressions are elongated instead of being round.

Lothotones—commonly known as one way screen halftones. Produces lines in one direction only instead of dots.

Phototypes—made through the use of a special screen and called split screen halftones. The screen appears to be finer in the shadows than in the highlights.

Aquatones—term used when copy produced from an extremely fine halftone screen. (300 to 400 lines per inch).

The dots in a halftone screen may run from 50 to 400 per inch. Moire effects are obtained when a halftone copy is reproduced by a halftone plate, and are usually present to some degree in process color reproductions.

### *2D—Halftone Color Plates*

These include Duotypes, and two, three, and four color Process Halftones.

Duotypes are produced from two halftone plates each made from the same black and white copy and negative, but etched differently to produce desired color shades. As the dots are in the same place the plates must be printed slightly out of register. These are also known as Duo Tones. They are cheaper than two color process halftones and there is no design to the dots under enlargement. Two Color Process Halftones are produced from two halftone plates each produced from different negatives of the same black and white or color copy. The screen has been placed at different angles in each negative. These are sometimes called Duographs and there is a definite pattern to the dots when observed under some enlargement. The plates are printed in black or brown and some lighter color. Three colors may also be produced by this method. Three Color Process Halftones are made from three halftone plates each made with a different negative of a colored copy. For each negative a different filter is placed over the camera lens. These are red-blue, yellow-blue and yellow-red and the plates produced print yellow, red and blue respectively. All the primary and secondary colors are produced or apparently produced by the use of these three plates.

Four Color Process Halftones print yellow, red, blue and black and the normal sequence of printing is in that order. The black strengthens the detail and carries most of the shading. Extra colors like gold, silver or bronze must be printed separately on a line etched plate. An apochromatic lens is used for process color work. This lens is corrected to give the same focal length for all the primary colors.

Halftone negatives may be "stripped" with line negatives and produce a "combination" plate or each may be printed separately called double printing or Sur-printing.

Mezzographs are produced with a screen having no design or alignment to the dots.

### *3—Screenless Continuous Tone Plates*

This includes the Photo Gelatine Process and Photogravure.

The Photo Gelatin Process is also known as litchdruck, photo-type, albertype, artotype, heliotype and collotype. A glass or metal plate is covered with gelatin and ammonium bichromate. A continuous tone negative which has been reversed by reprinting, stripping or the use of a prism on the camera lens, is then placed over the plate and exposed to light. This hardens the gelatine in direct proportion to the amount of light passed. The plate is then soaked in a



water-glycerine mixture which is absorbed by the unhardened gelatin. This swells the gelatine and loads it with water which makes it non-receptive to the greasy printing ink. The shallowness of the plate does not permit the heavy application of ink.

Photogravure uses a copper plate covered with a finely powdered resin, dragons blood, or bitumen which is fused on with heat. Small areas of copper are left bare between the particles. A positive is printed on sensitized gelatine which is then placed on the plate which is then washed and etched with perchloride of iron. After the etching, which produces an intaglio plate, all gelatine and grains of resist are removed with hot potash. The plate will then produce a nearly continuous tone image.

Generally speaking all camera lenses are subject to some distortion and the various other photographic processes lead to distortion, therefore extreme accuracy over all the printing plate is impossible except by the wax engraving or similar method of making letterpress plates.

Normally one printing plate is used to print one color of ink. By using the Split Font or Split Roller technique, more than one color can be printed by one plate at one time. The split font produces a graduation from one color to the other while the split roller produces a sharp line or break. Both techniques produce bands of color running parallel to the direction of feed.

The printing of all the letters of one's surname, and often the first name and middle initial, in a design like a monogram is called a Kalogram. If it is a combination of two or more letters or words, as in a slogan, it is called a Logotype.

### ***Duplicate Plates***

This includes Electrotypes, Nickletypes, Aluminotypes and Stereotypes. These are often used for the actual printing instead of the original forme, especially in the newspaper business where printing establishments in different areas wish to print a common material all at approximately the same time.

*Wax Moulded Electrotypes*—a plate of ozokerite or beeswax is pressed into the forme. It is then given a coating of black lead and plated with copper to approximately .015 inch. The shell is then backed with a soft metal.

*Vinylite Moulded Electrotypes*—the forme is pressed into vinylite which is then given a silver spray before plated with copper. These are used for medium screen halftones, line etchings, type, etc.

*Lead Moulded Electrotypes*—the forme is pressed into a sheet of lead then copper is plated onto the lead mould and the shell is backed. The pressure required is too great for duplicating type and the method is used mainly for fine screen halftones.

*Nickletypes* are made in exactly the same way as electrotypes except nickle is used to make the shell instead of copper. A nickle plated electrotpe is not a nickletpe. Nickle is used for fine screen halftones printing color work.

*Aluminotypes* are made by casting the forme in plaster of paris. The casting is then filled with a hard alloy of aluminum. No backing is needed and the method can be used for type and coarse screen halftones.

*Stereotypes*—Sheets of paper mache or plastic are hammered into the type and cuts with a brush, or rolled into the forme with a matrix rolling machine. This matrix is dried and placed into a flat or curved casting box. Metal is then poured or pumped into the box. This method is very hard on type. The stereotypes are sometimes nickle plated to wear longer and for use with colored inks. Rubber plates are made in a similar manner except the first



or negative case is usually taken in bakelite. Rubber plates are used to print on plastic. Cellophanes, and wax paper, but some firms use this method exclusively for all letterpress printing.

### ***Duplicating Processes***

Duplicating processes may be grouped under the following general headings:

- (1) Carbon paper methods
- (2) Press Copy process
- (3) Gelatine or Hectograph process
- (4) Spirit or Fluid process
- (5) Stencil or Mimeograph process
- (6) Xerography
- (7) Photocopy
- (8) Printing type duplicators.

#### *Carbon Paper Methods*

The single-sided carbons are most popular. The very heavy types are usually called billing carbons. These must not be confused with pencil carbons which are for use when the original is written in pencil.

Two sided carbons are generally used with very thin and practically transparent paper and can make up to 25 to 30 copies in typewriting. The sheets of paper placed above the interleaved carbon sheets receive a reversed impression which must be read through the paper. It is claimed that the use of two sided carbon for pencil or pen written material, producing a reversed copy on the back of the original, is a protection against unauthorized alteration.

There are also, understandably, many other types and grades of carbon paper for use under various conditions. Carbon paper is used in the various manifolding processes such as loose copies for typewriting, and manifolding sets and continuous forms.

Some terms appearing in connection with these sets and continuous forms are:

- (a) Carbotyp—forms or sheets of paper secured by a stub and the carbon paper has to be inserted.
- (b) Carbograph—the carbon paper is inserted by the manufacturer and forms part of the set.
- (c) Carbac or Transkrit—the back or part of the back of the sheet or form is carbonized.
- (d) Roll Form—continuous sets in a roll.
- (e) Interfold—continuous sets attached at top and bottom and folded accordion style.
- (f) Fanfold—continuous sets attached at the sides and folded accordion style.

Continuous sets of forms are used in Manifold Registers such as the Paragon, Moore, Standard, National and Egry Registers and in continuous stationery attachments to typewriters.

#### *Press Copy Process*

Uses diluted hectograph ink for writing with pen, or a copying ribbon for typing on an original. The original and thin tissue copy paper are ran together over a pressure roller. The copy produced is a mirror image and shows through as a positive. The names of two of these machines are the Roneo and the Rotadar. This is not a common or popular process.

## *Gelatine or Hectograph*

This is the oldest method of duplicating. The original text must be written, drawn, typed or printed with hectograph ink (usually methyl blue) on a sheet of paper called a "Master". This master is then placed face down on a gelatine block, pad, blanket or roller and left there for about one second for each copy required. The dye is absorbed into the gelatine from the master. The master is then removed and the impression paper is placed on the gelatine. This impression paper should be, and usually is, a soft absorbent paper with no special coating. The copy is usually fairly intense in color in the case of the first copies ran off and the lines tend to diffuse somewhat into the paper, particularly in the latter copies obtained. or when the dye is left in the gelatine for some time. If a heavy pressure is applied in putting the ink on the "Master", blank spots may occur in the centre of the reproduced lines. It is a cheap and simple process but limited to from 50 to 100 impressions and the dye is usually fugitive to light. This process has been replaced largely by the Spirit process.

The names of some of these hectograph process machines are Heyer, Hectograph, Autocopy, Columbia, Gel-Sten, Graphic, Hectographia, Repeater, Redegraph, Crusader, Ellams, Tablograph, Ditto, Facsimile, Ormig and Standard.

The largest Canadian supplier of hectograph equipment appears to be the L. A. Reeves Ink Co.

## *Spirit or Fluid*

The first fluid process machine was called the Ormig and made by Block and Anderson of London.

The reversed impression of the image to be reproduced is placed on a sheet of paper, called the "Master", with a dye (usually methyl blue). This dye which may be colored blue, black, purple, red, green or brown, is usually supplied on a sheet of paper (carbon paper) attached at the back of the master. The dye adheres to the back of the master as it is written, drawn, or typed upon, or it may also be printed on the back of the master by a printing process. This printing technique is used when the material copied is duplicating printers type or line illustrations, and these masters are usually made up by the supplier of the machines.

Spirit masters can also be produced by the Xerography process which will be explained hereunder.

The master is normally placed on a drum in the machine, but may be placed on a flat surface (e.g.: in the "Master" machine). The impression paper is then moistened with a fluid and placed in contact with the side of the master bearing the reversed impression. The various manufacturers of this fluid advertise it as a carefully balanced combination of solvents and plaster-cisers, but in some cases the container it comes in merely displays the words "methyl alcohol". It does, however, contain a substance which makes it impalatable.

This process produces a sharper, but usually a less dense, image than the gelatine process. The copy may have a light or heavy area or smudge running in the direction of the feed of the paper through the machine. In areas where heavy pressure is applied to the face of the master, causing a protrusion at the back, it appears that the dye soon wears off. This leaves a blank in the center of the area being reproduced as in the gelatine process. These blanks would also occur if the pressure of the impression was so great as to actually punch a hole in the master sheet. In reproduced typewriting this occurs in expected areas such as "i" dots, periods, etc. These blank spots may also appear in copies produced by the transfer photocopy process (explained below), but in this case the blank areas, whenever they do appear, are generally throughout the text.

A hard smooth surfaced "tub sized" paper is usually used for taking the duplicates, and up to 500 copies are possible. Ordinary bond paper, however, will work satisfactorily.

All Spirit duplicators operate in a similar manner and most have similar mechanical features. It is possible for most to use supplies made specifically for different makes of machines. For examples "Ditto" supplies (i.e.: master sheets, fluid and impression papers) are commonly used on the Speedliner and Fordigraph machines and probably many others.

The names of some of the Spirit process machines are: Copy-Rite, Speedliner, Old Towne, Plentograph, Heyer, Fordigraph, Beck, Copy Plus, Ditto, Master, Duplicopy, Repeater, Rex-o-Graph, A. B. Dick Azograph, Rocket and Copyrex.

The Ditto, Master and Repeater machines seem to be the most popular. It may be extremely difficult to differentiate between material produced by the gelatine and spirit processes. Both use a similar dye which will dissolve and spread on the application of a spot of alcohol.

### *Stencil or Mimeograph*

The wax stencil process was invented in 1881 by David Gestetner and was called the Cyclostyle.

This process usually makes use of a stencil consisting of a long fibred porous paper coated with an ink resisting wax or lacquer. This stencil can be "cut" by hand using a stylus or special roller, by a typewriter, by a specially prepared plate (similar to a letterpress printing plate), by an electronic stencil cutting machine or by the photomechanical process.

During the duplicating process, ink is forced through the areas of the stencil that are cut. The ink used is usually an oily base type, and the paper used should be soft and absorbent.

The ink, in some cases, especially when colored other than black, will separate after being on the paper a few days, and will produce a somewhat translucent halo or "strike through" around the duplicate text. Some firms, including A. B. Dick and Gestetner, however, have produced a "hard set" ink which eliminates this separation.

The Gestetner and Rex-Rotary (Murdock-Rex) firms appear to be the leaders in the field of stencil duplication, followed probably by A. B. Dick.

Most of the machines in use have a large hollow cylinder made of a porous material. A rather fluid ink is placed inside this cylinder and oozes through it to the stencil. Both Gestetner and Rex-Rotary machines, however, use a two cylinder setup and an ink of heavy viscosity is placed on the outside of these with oscillating inking rollers, similar to those used in lithographing machines. This two roller method appears superior to the use of the hollow cylinder in producing sharp, clear copy. This is probably due to the difference in ink viscosities.

It should be remembered that owing to the new electronic and photo-mechanical processes, line and halftone illustrations may now be produced by the stencil process.

The names of some of the stencil machines in use include: Mimeograph, A. B. Dick, Heyer, Speed-O-Print, Print-O-Matic, Elliott, Polychrome, Letter-graph, Vari-Color, Rex-Rotary, Gestetner, Rolo, Roneo, Secam, Arlac, Swallow, Ellams and Esco.

### *Xerography*

Xerography is used to prepare offset paper plates, offset pre-sensitized metal plates, translucent intermediates for Diazo printing, masters for spirit duplicators, and up to eight positive duplicates direct from an electrified negative image.

To produce direct positives a specially coated paper is given a positive static electrical charge. The image of the original is projected through a camera lens onto this paper, and the positive charge disappears in areas exposed to the light. A negatively charged powder is dusted over the paper and it adheres to the positive charged image which had remained. The positively charged copy paper is placed over this image and receives a portion of the powder from it. The print is then heated for a few seconds to fuse the powder. This powder appears to be made of a carbon based material and is applied to the paper in the form of small round balls, similar in appearance, one could say, to the "flavour buds" of some forms of instant coffee.

The direct copies, when made by this process, bear a likeness to material printed by offset lithography. This duplicated material looks hard and shiny on the surface of the paper, but when viewed under magnification, numerous small dots can be seen scattered in the blank areas, and the printing has a matted, sprayed-on appearance.

Xerography equipment is made by the Haloid Company of Rochester, N.Y. and is distributed in Canada by a branch of the same company in Toronto.

### *Photocopy*

Photocopy machines are becoming very popular and because of their speed and versatility, are replacing the other methods of duplicating. By various methods they print on sensitized paper, usually using the original as a negative and exposing through this to produce the copy. Most use light for the exposure and a combining agent like ammonia or potassium carbonate for developing and stabilizing. The impression paper, bearing material produced by photocopy, will always have some form of fixed photo-sensitive or heat-sensitive coating on a glossy finish.

The various methods of direct photocopy can be dealt with under six general headings as follows:

(1) *Whiteprinting*—This process requires a transparent or translucent original. Most white bond papers having material on one side will suffice. The original is placed on contact with the sensitized copy paper and exposed to a strong light. Initially the sensitized coating is usually yellowish in color and this material is burned off or stabilized in the blank areas by the intense light. The copy paper is then exposed to ammonia fumes or potassium carbonate which develops and fixes the image. The sensitized areas which are left orange color during the developing; turning blue if of ferro-gallic type, brown if a cyano type, reddish if sepia or black if a mixture of dyes.

When the originals have material printed on both sides a transparent or translucent intermediate must be prepared from it as a preliminary step. This intermediate is then used for the negative in the machine.

Most of the whiteprinting machines sold in Canada are handled by Hughes-Owens and Instruments Limited.

The Antara and Ozalid machines, made by the Diazo Division of the General Aniline and Film Corp., Johnson City, N.Y., are distributed in Canada by Hughes-Owens.

The Antara machine is used to make direct whiteprint copies, but Ozalid machines will also make paper or aluminum plates for offset duplicators. The Ozalid process usually produces blue lines on a white background, but can also produce black or red lines.

Instruments Limited now handle the Pease whiteprinting machines.

The names of other machines of this type include Diazo, Meteor Revolute (Revolute of Rochester, N.Y.), Copyflex (Charles Bruning of Chicago), and Zimco.



When fixing has been done by ammonia a characteristic pungent odour can be detected from the copy for a considerable time after it has been completed. The copy paper may or may not have a watermark.

(2) *Blueprinting*—In this process the copy paper is coated with a mixture of ferric ammonium citrate and potassium ferricyanide. The original is placed over the copy paper and the action of light changes the ferric ammonium citrate to the ferrous salt, and washing in water removes the unchanged ferric ferricyanide thereby developing the print leaving a white outline on a blue background, of insoluble Turnbull's Blue ( $\text{Fe}_3(\text{Fe}(\text{CN})_6)_2$ —ferrous ferricyanide).

(3) *Photostating*—(a) The production of duplicates by contact onto a reflex paper—This is a familiar process and many refer to it as the "Reflex" process.

(b) By projecting the image onto the copy paper through a lens—The Duomatic machine made by Duophoto Corp., N.Y., makes a permanent paper negative in this way. This then is used in a normal reflex method to give positives. The Duomatic machine will provide black and white positives of opaque originals, or negative and positive reflex prints. It has a built in drying unit and will produce enlargements from microfilm.

The Lucigraph, Photostat and Rectigraph machines produce positives direct on sensitized bromide paper by mounting a prism on the front of a camera lens.

(4) *Photography*—This can be considered in this general heading of Photocopy.

(5) *Thermocopy*—The only popular machines known to use this process are the Thermo-Fax machines made by the Minnesota Mining and Manufacturing Co., St. Paul, Minn. These are distributed in Canada by their Canadian Branch in London, Ontario. There are three models: "Secretary", "Fourteen" and "Premier".

These machines use a heat sensitive copy paper and a light source with a high concentration of infra-red radiation. The original and impression paper is put through the machine in contact with each other, and that material that is opaque to the infra-red radiation creates sufficient heat directly above it to turn the heat sensitive coating of the impression paper a deep blue colour. The impression paper may come in one of five colours: white, yellow, pink, green or buff. It has a translucent waxy appearance and will readily turn a bluish colour upon the application of heat. Obviously this process will not copy original texts that are not "opaque" to infra-red rays.

(6) *Transfer Photocopy*—With all machines of this type a negative image of the text being duplicated is formed, by a reflex method, onto a sheet of sensitized paper, from the original. The impression paper or positive paper is then placed in contact and under pressure against this image, which is transferred to the positive paper by a chemical reaction, and *not* by an exposure with light, making the finished copy. With most transfer photocopy papers only one positive can be taken from each negative; in a few two positives can be recovered; and in one, up to twelve positives can be obtained from one negative.

Most of these machines operate in a similar manner mechanically. Some have a separate printing frame (e.g. Verifax) for exposing the negative. Others do this within the machine which also develops the negative and presses the impression paper onto it.

The positive paper is not sensitive to light and one side is emulsion coated with a glossy finish. The negative paper is moderately light-sensitive.

Transparent positive paper is supplied and can be used as intermediates with Bruning, Ozalid and other diazo-type machines. Offset lithographic plates can also be prepared by these photocopy machines.

Some of the names of the machines using this process are Apeco Auto-Stat (American Photocopy Equipment Co., Chicago), Duoprinter (Duophoto Corp.), A. B. Dick, Banda (Block and Anderson), Copyflex, Photorapid, and Verifax (Kodak Co.).

There are two types of negative paper with the trade name "Copyrapid", one for making single positives and another for making two positives. The verifax machine uses a negative paper from which 5 to 12 positives can be taken.

The negative and positive papers used in this process may have a trademark printed on the back such as "Gevaert" or "Copyrapid".

The image on the positive is usually a dense black or dark brown colour. The paper usually has a hard glossy surface, and if the developing chemicals are not kept fresh the lines of the positive image will contain blank areas more or less throughout the surface of the sheet.

### *Printing Type Duplicators*

The printing type duplicators are actual printing presses but because of their small size, the fact that they do not usually produce high quality work, and because they are used in business offices, they are called duplicators. Also owing to their low cost, availability to the general public, and the fact that they employ a printing process that can make duplicates of letterpress or planographic originals in their correct printing method, these machines may be involved in cases brought to the document examiner more often than any of the other types of printing or duplicating machines.

The greatest number of printing type duplicators are offset lithographic machines, but some use letterpress plates on type.

The offset machines include the Multilith, Davidson, Ditto, Rotaprint, A. B. Dick, Gestetner, Schwarz Presse, Opalograph and Ordoverax.

The plates used on these offset machines can be paper or metal and these are prepared by typing on them directly using a special ribbon or carbon ribbon, drawing or writing on them by hand, by a photomechanical process, by Xerography, by Transfer Photocopy machine, by the Diazo process, or by a Stenafax Electronic Facsimile Copier.

Both line and halftone work are produced by these offset machines; and also colour process work, but the register is none too sure. Most of these machines use the three cylinders (i.e.: plate, blanket and impression cylinders). Some of the Davidson machines, however, use one large cylinder for both the plate and impression and one smaller cylinder for the blanket.

This offset process uses a printing plate having the printing areas level or relatively level with the non-printing areas. Printing made by this process can be indicated by the thin even deposit of ink, in some instances the lack of a well defined edge to the printed material, and the absence of any indentation or embossing in the paper, and the presence of blank areas in the center of printed areas.

The letterpress type of machines include the Addressograph, Multigraph, Davidson, Ashlock, Shannontype, Gammeter, Roneotype, Rib. Dapoy and Hooven.

The Addressograph uses a thin metal plate on which raised characters have been stamped. These are pressed against the paper or envelope through an inked ribbon.

The Multigraph is a rotary type press using type set in parallel grooves in the surface of the printing cylinder. This type may be inked with an inking device, or may be printed through an inked ribbon to simulate typewriting. It is also possible to use curved electrotypes in place of the type.

The Ashlock and Shannontype use a flat bed instead of a plate cylinder. The Ashlock is actually a platen type press, and the Shannontype uses an inked ribbon and type that are designed to simulate typewriting.

Multigraphed copies printed from type which are designed to simulate typewriting and printed through an inked ribbon can be distinguished from typewriting as inter-line marks or dots from the solid ribbon can be seen running from one line to the next; the vertical alignment as viewed from one line to the next will not be as perfect as in typewriting, particularly towards the right hand side of the material; the display of heavier pressure in the shorter lines; the ruling being solid from end to end; and the absence of corrections such as typewriting strikeouts.

Material produced by relief type or plates inked directly will show a noticeably heavy deposit of ink at its edge or rim in addition to the embossing of the paper being heavier in short lines and small areas. In some cases the ruling may be broken up to simulate typewriting more closely.

Another form of duplicating appears in the transmitted wire and radio photos as produced by Associated Press Wire Photo transmitters and receivers, Telefax, and the Western Union Desk Fax and High Speed Fax machines. Although almost all of these machines are presently located in, or connected with newspaper and telegraph establishments, they may well become popular among large corporations having numerous branch offices.

These processes make use of a photoelectric cell scanning the original and the impulses created by this cell is wired or radioed to the receiving machines. The duplicate can be made in a number of ways: (1) by a glow lamp over photographic paper, (2) by an electric current being discharged through a paper treated with molybdenum salts, (3) by a heat sensitive paper being developed by a heated stylus (similar to Thermo-Fax), (4) or by forcing carbon paper into contact with ordinary white paper by electromagnets.

Some further mention should be made regarding the electronic plate and stencil cutting machines.

The three stencil cutters are the Stenafax (known to be used by Gestetner and A. B. Dick to prepare stencils for their customers), the Roneo (used by Roneo), and the Electro-Rex (used by Murdock-Rex to prepare stencils for their Rex Rotary machines).

For reasons of space a description of these machines are purposely omitted. It should be appreciated, however, that with these stencil cutting machines line and halftone illustrations can be made by the Stencil process. Line and halftone illustrations can also be made by this process when a special stencil, having a coating sensitive to light and developed photographically is used, but fine detail cannot be duplicated satisfactorily.

Other electronic plate making machines like the Scan-A-Graver (Fairchild), Clichograph, Elgrama and Luxograph produce halftone illustration areas for letterpress or relief printing. It is sometimes possible to differentiate between plates and material produced by each of these machines. The majority of these plate cutting machines are found in newspaper establishments.

There are probably less than ten of the stencil cutting machines in Canada, but this number is expected to increase considerably.

It should also be appreciated that, with the photomechanical Xeroxing processes, line illustrations and duplicates of material produced by printer's type, can be made by the Spirit or Fluid process.

To determine if a particular copy has been prepared by a particular process requires some knowledge of the duplicating processes available, and of the mechanics of the machines using each process. To determine if a copy has been printed from a certain master, stencil, plate, etc. requires a working knowledge of what identification features are significant and what are not; and the proper interpretation of all of them.



The nature, purpose and text of the material or copy, in addition to the physical characteristics of the printed areas and the type of paper used, will assist in determining the method or methods employed to produce material on a document.

The identification of a particular machine as having produced copy on a document is a most difficult problem, particularly when the printing plate or master has been lost or destroyed. In this case careful examination of the document for ink stains or smudges, and disturbances on the surface and edges of the paper must be made. It is difficult to disclose such marks or to give them significance until the actual machine, suspected to have been used, is examined. Particular attention must be given to all parts of the machine that touch the paper during its travel through, and especially the feeding mechanism. These parts will have a different construction on different makes of machines and probably have a different adjustment in each of the machines of the same make.

### **Remarks**

The purpose of this paper is to give a general idea of some of the different printing and duplicating methods in use, and a few features by which some can be identified or indicated. It does not contain complete information on these fields, nor much of the technical information which an examiner should have when dealing with problems involving the counterfeiting or forgery of documents by printing or duplicating process.

The study of the fields of printing and duplicating is an immense task. The most expedient method seems to be for the examiner to obtain a general and basic knowledge of the processes, then look for and study the information on a particular phase of these fields as it applies to a particular examination confronting the examiner.

### **Discussion of Mr. Headrick's paper**

COLE: I want to mention this difference between certain processes, that in a diffusion transfer process there is transferred from your negative copy to another sheet of paper, unexposed and undeveloped silver salts which are later blackened by an appropriate development. Now in a process which also involves a kind of transfer but which is properly called a matrix process, that represented by Verifax and Photostat Instant Copyer, the really interesting feature is that the transfer can be made to ordinary good bond paper, and for that reason there is some danger that a copy made by a photo copying process whose final results are on a bond paper might be mistaken for an original.

HEADRICK: Thank you very much Mr. Cole. I should point out my knowledge on this is mainly theoretical. I have not had a chance to look at all of these processes very closely.

GODOWN: I would like to take a very mild issue with you on the importance of this in document examination. I think it is going to be tremendously important because these machines are being widely sold to Attorneys for use in their offices and you are going to see more and more of them. I have already encountered problems where it was important to determine how much detail in typewriting identification was lost through certain processes and how reliable an opinion might be, based on a Thermofax copy, let us say, being the only thing that now exists, the original having been lost. Does anybody know what the final Verifax image is? I am under the impression that the final image that is transferred to the paper is very permanent, I think it is carbon so that you have perhaps a more permanent image there than you had in the original.



BOONE: Often times you can get a very rapid infra-red view by putting a cheque under a Thermofax machine. It will show up erasures sometimes.

PURTELL: A problem that I have run into in Chicago of late involves some of our good con outfits who obtain a person's signature by some fraudulent method, make a photo copy, lay it on a wage assignment and then take a photo copy of it. Two or three days later they will appear at the man's place of employment and demand payment on a wage assignment and the only thing that will be produced will be the photo copy. The ones I have run across are Verifax. Here you have a genuine signature but the only thing you have to work on is the photo copy.

HEADRICK: We have had a number of counterfeit banknotes prepared by even such processes as the Thermofax process, and have had counterfeit plastic plates, made by electronic plate cutting machines, such as the Scan-O-Graver.

## Security Printing

H. W. JACKSON  
Canadian Bank Note Company  
Ottawa

This paper outlined the process of manufacture of Canadian currency, stock certificates, bonds, and other negotiable documents. The different security features introduced in such documents, and their relative merits, were discussed and illustrated by means of samples which were circulated among the audience. The security measures necessary in the organization and control of an institution charged with the production of such documents were also disclosed.

For obvious reasons it has not been considered in the public interest to publish this information in a volume to which the public might have ready access.

This address and its ensuing discussion has therefore been printed separately in a supplement to this volume, and is available at no charge to law enforcement agencies or other departments who can justify their requirement for such information. Applications should be addressed to:

The Officer in Charge,  
Crime Detection Laboratories,  
Royal Canadian Mounted Police,  
Ottawa, Ontario.

# The Relationship of Mathematical Probability to the Handwriting Identification Problem

ORDWAY HILTON

New York City

In every handwriting identification we are dealing with the theory of probability. If an opinion is reached that two writings are by the same person, we are saying in effect that with the identification factors considered the likelihood of two different writers having this combination of writing characteristics in common is so remote that for all practical purposes it can be disregarded. Such an opinion is derived from our experience and is made without formal reference to any mathematical measure. However, the mathematician provides us with a means by which the likelihood of chance duplication can be measured. It is the purpose of this paper to explore the possibility of applying such mathematical measure to the handwriting identification problem to see how we might quantitatively measure the likelihood of chance duplication.

## Basic Mathematics

For many problems the mathematical theory of probability is extremely simple. While the necessary theorems do not involve complex mathematics the applications of them to practical problems may be much more involved. Let us consider first the basic mathematical formula. (1)

A few terms need definition. When a particular event occurs, it is referred to as a *success* (s); if it does not occur, as a *failure* (f). If the event can occur in  $s$  ways and fail in  $f$  ways and all of these ways are equally likely to happen, then the probability of success (p) is defined as  $p = \frac{s}{f+s}$  and the

probability of failure (q) as  $q = \frac{f}{f+s}$

From manipulation of these fractions it is apparent that the sum of the probability of success and failure is 1, that is,  $p+q=1$ . If an event is certain to happen it has a probability of 1, and if it cannot happen, it has a probability of 0. It can be seen from the definitions that the values of probability of success and failure,  $p$  and  $q$ , always lies between 0 and 1. Thus, probability is expressed either as a fraction or as something which may happen once in so many times. ( $s$  times out of  $f+s$ .)

Now, if we have several events, each with their probability of occurrence as  $p^1, p^2, p^3, \dots$  up to  $p^n$  and each event is independent of every other, then the probability of all events happening simultaneously is the product of their individual probabilities. ( $P = \prod_{i=1}^n P_i$ )

When we say that an event is independent of every other event, we mean that if it happens, this has absolutely no effect on the probability that the other events will or will not occur.

There are two important conditions in these simple definitions which must hold if our probability determinations are to be accurate. The first is the

condition of equal likelihood. This simply means that each occurrence of an event must be just as apt to happen as any other. When there is no specific evidence to the contrary in a handwriting identification problem the condition of equal likelihood is assumed to hold. The other condition is the mutual independence of successive events in the determination of the probability of several events happening simultaneously. This means that if the first event should happen in any particular way this will have no influence on how any of the successive events occur. We find in handwriting problems that this condition must be considered with extreme care or else our probability factors will have little meaning. The error caused by ignoring this condition of mutual independence can lead to a probability determination which appears much rarer than it actually is.

### ***Historical Cases Involving Probability Measurements***

Any formal computation of a mathematical measure of probability in connection with handwriting identification problems has indeed been rare. Only one reported case can be located in which any evidence was given to the court on this subject. This is the famous Sylvia Ann Howland case which is described by Dr. A. S. Osborn in his "Questioned Documents". (2)

The case involved a traced forgery on a codicil, the tracing having been made from the genuine signature to the will. Testimony was given by Professor Pierce regarding the probability that the thirty downstrokes in the codicil signature would exactly coincide with the corresponding downstrokes in the will signature. Professor Pierce based his calculations upon the fifty genuine signatures in evidence in this case, determining from them the probability of certain strokes coinciding in two signatures. Based upon the data so obtained, he then proceeded to calculate the probability of the thirty points of coincidence by the joint probability theorem, which is reported as one in 931 quintillions, e.g. 931 followed by 18 ciphers.

To digress to typewriting identification problems momentarily there is in this branch of questioned documents a single reported case, the Risley trial. (3) In this case a mathematician testifying on the probability aspects of the identification made a series of assumptions as to the likelihood of occurrence of individual defects without the benefit of actual study or without showing knowledge and experience as a typewriting identification expert. Upon review the case was reversed because of these deficiencies. This appellate decision warns that if mathematical measures are to be used they must either be based upon special study in the particular field of identification or some statistical analysis and not mere assumptions.

### ***Typical Problems***

The Howland case illustrates one type of handwriting identification problem in which mathematical measures may be applied. Here was the actual determination of the likelihood of two signatures coinciding at a series of consecutive points or strokes. One was the disputed signature or traced forgery, the other the model from which it had been made. The low probability ratio, a very slight likelihood of chance coincidence, formed further proof that the disputed signature was a traced forgery. This is a very limited application, but one in which it would be easiest to establish the various individual probabilities of two consecutive strokes coinciding by simply studying the available genuine signatures. The joint probability ratio could then be calculated by simple multiplication.

The need for probability determinations in the more general identification situations has been pointed out. Professor Paul L. Kirk in his "Crime Investigation" (4) states that Dr. Osborn "does not, in his entire book, cite one actual probability of occurrences of any single factor which he discusses. Handwriting analysis, despite statements to the contrary, cannot be truly 'scientific' until such serious omissions as these are repaired". Chas. O'Hara and James W. Osterburg discuss the application of probability to the handwriting identification problem (5) without expressing a similar strong objection to present day handwriting identification methods. These statistically minded authorities have had at best limited experience in the identification of handwriting and while they may appreciate some of the complexities of applying probability measures have certainly not clearly stated them in their writings.

Measuring the likelihood of accidental coincidence in the general handwriting identification problem is far more complex than under the situations presented in the Howland traced forgery. The difficulty is not so much that of mathematical or arithmetical operations although we shall see that there are some complexities in this field, but rather is that of assembling the basic data from which to calculate the joint probability value. To do this we must study more than one individual's handwriting. In fact we must know how often each identifying factor occurs among all writers who could have produced the document, for example all writers in the United States and Canada or in New York City depending upon the investigation. Furthermore, not just certain classes of characteristics or qualities, but rather all should be considered.

Once this basic data is available for each identifying factor we can then resort to the multiplication theorem to calculate the likelihood of chance duplication. With handwriting identification, however, there are several considerations which should be analyzed before we can decide whether it would be worthwhile to make the extensive study necessary to establish the basic probability factors.

### *Special Considerations in the Handwriting Problem*

Three hurdles stand in our way of calculating a measure of the reliability in any handwriting problem. Variation, common to everyone's handwriting must be reckoned with. The question of the degree of independence between various identifying characteristics must be investigated. Finally, both the practical measurement and the mathematical handling of those very important identification factors such as skill, writing speed, freedom, shading and related writing qualities must be solved.

*Variation*—Writing variation causes an identification factor to occur with slight modifications in successive specimens. To take the classic example which all non-experts, statistically minded workers cite in connection with a suggested probability determination, the open topped "a", the question immediately arises with a series of open "a's" by the same writer just how open this letter is. In some instances the gap will be very small, it may even occasionally be closed. In other instances the opening may be so wide as to make the letter look like a "u". Thus, the variation factor forces us to decide that if an open topped "a" has a certain probability value then does this value undergo any adjustment when the letter is only slightly open or when it is very open. There are many other aspects of handwriting variation and how each is to be handled in probability determinations requires decision. Arbitrary definitions or decisions, probably somewhat personal to each worker, may have to be developed in much the same way that these procedures are developed in presenting the problem of variation to a jury.



*Independence*—Independence in the probability sense is a necessary requirement for each identifying factor and one frequently overlooked by non-mathematicians discussing the problem. For example, rapid careless writing may be reflected in the writer's failure to close his "a's". Finding this fault in his "a's" we should expect to see it carried over into the "a" portion of his "d's" and possibly into the "g's" and "o's". Here is an illustration of four non-independent probability values. By knowledge of the writing process we find that all are derived from a similar cause of carelessness and fast writing. To look at another type of non-independence let us consider the design of letters as they are influenced by the basic writing system which the individual learned. For a number of years the Palmer writing system taught that the vertical staff of the "d" should be a loop while Zaner-Bloser set their copy with a retraced stroke. The "r" which starts like an "n" was also distinctively Palmer. Thus, a writing containing this form of "r" and a looped staff on the "d" may, because of early training, have two forms that are not independent. Yet if we use a predetermined probability factor for each and in calculating the joint probability value fail to recognize this interrelation, we arrive at a final probability value which indicates less likelihood of coincidence than is actually the case. Errors in this direction must be eliminated at any cost.

What we have now come face to face with is the mathematical concept of correlation, a measure of the interrelation between two variables or the measure of their lack of independence. To handle this problem successfully, much more complicated calculations are involved than heretofore.

The development of the mathematical formula for the correlation coefficient,  $\rho$ , will not be attempted here as it involves certain background mathematics which would extend this discussion. Rather, by consulting the reference text the reader can obtain the working formula (6). Let us only observe that the value of  $\rho$  varies between  $-1$  and  $+1$ .  $\rho=0$  represents independence in the probability sense and in practical situations low absolute values of  $\rho$  can be considered as indicating a lack of marked correlation between the variables, that is independence in a practical sense. In every attempt to set up probability factors the correlation between data should be tested unless its existence or non-existence is obvious.

*Writing Quality*—Finally let us consider writing quality—those factors which Dr. Osborn has grouped together under the term *line quality*. Various letters can be distinguished and segregated into class forms so that ten or fifteen different forms of a "g", for example, can be defined. It is then possible to determine their frequency of occurrence in a particular national handwriting system. Writing skill, on the other hand, cannot be readily broken down into these discrete compartments. Rather skill is graduated from very low to very high. This is true of writing speed, shading, or any of the other elements of line quality.

A mathematician would describe measures for these factors as a continuous function since there is no definite line of demarcation between adjacent degrees. Mathematical formulas which we considered early are in a form which can only be applied to the discrete case, that is a case in which we have a definite number of distinct groups like fifteen forms of the "g" proposed above. The continuous function might be compared to a line which to the mathematical eye is an infinite series of nondimensional points packed so tightly together that there is no break or interruption between them. Probability determinations involving continuous functions can be handled by mathematical techniques, but the practical problems become extremely complicated.

At this point it may be asked whether the problem could not be simplified by simply omitting identifying qualities of this nature and using only the discrete factors of form in our probability determination. This is hardly a valid approach because we certainly cannot accurately identify handwriting

without considering writing quality and all of its implications. We all know that there are certain forged signatures in which the letter forms are accurately imitated, but that the writing quality readily distinguishes between the genuine and the forged. Are we then to establish a probability of identification in which we indicate that the forged signature was genuine by the simple expedience of discarding the main factor of nonidentity. Obviously omissions is not a solution to the problem.

To handle the mathematics requires consideration of the calculus. Rather than defining the joint probability ratio as a product of the individual probability ratios we now define it as a multiple integral the series of probability functions which appears in its most general form as (7):

$$P = \int \int \dots \int f(p_1, p_2, \dots p_n) dp_1 dp_2 \dots dp_n$$

where  $f(p_1, p_2 \dots p_n) \geq 0$

This formula requires that the function,  $f(p_1, p_2, \dots p_n)$  be defined according to the conditions of the cases which in the handwriting identification problem under consideration is our toughest hurdle. Having gotten ourselves to this dilemma, we must now quietly retreat and figure out how by making certain approximations we might handle this phase of the problem in terms of multiplication of factors as we did originally with factors of form.

The approximating technique merely goes back to what a few paragraphs ago we recognized as difficult. We must break skill, writing speed, etc. into small compartments. By defining skill for example as very high, high, good, average, poor, and nearly illiterate, we can characterize each writing as belonging to one of these groups and calculate the frequency of occurrence. The same with speed, with shading, with freedom of writing, and so on. These factors, while handled somewhat arbitrarily we must recognize, are handled in the only way which allows us to apply any mathematical probability measure.

### **Testing The Probability Determination**

A calculation of a joint probability value under the criteria already discussed needs some appraisal or statistical testing. In this type of determination we are dealing with a number of factors, certainly at least 10 or 12 points of identification. Each individual probability factor is expressed as a fraction and the multiplication of 10 such fractions, even though each denominator is small, leads to a reasonably large value for the denominator of the joint value. Let us consider two sample cases. In each we have 10 points of identification. In the first we determine that the probability of the occurrence of each probability factor is  $\frac{1}{2}$ . Thus, the joint probability value is  $(\frac{1}{2})^{10}$  or  $\frac{1}{1024}$ . Considering a second problem where the individual probability value of each identification factor is  $\frac{1}{3}$  we calculate the joint probability to be  $(\frac{1}{3})^{10}$  or  $\frac{1}{59049}$ . With either problem under case situations in which the number of possible writers is limited to only three or four persons either joint probability value will tend to make a convincing argument to support the identification.

Before leaving these problems let us consider for a moment the possibility of nonidentity. In the first case the probability of nonidentity of each factor is  $\frac{1}{2}$  and the joint probability value again is  $\frac{1}{1024}$ . In the second case the individual nonidentity probability value of each factor is  $\frac{2}{3}$  and the joint value is  $(\frac{2}{3})^{10}$  or  $\frac{1024}{59049}$ , that is approximately  $\frac{1}{57}$ . Obviously, in the first case the argument for identification or nonidentification from a purely mathematical point of view is equal.

Olkin in a paper presented at the 1958 Annual Meeting of the American Academy of Forensic Sciences (8) proposed an evaluation of the identification problem in terms of the likelihood ratio statistic (9). This statistic,  $L$ , is

the ratio of the probability of the characteristics under the assumption of identity to the probability under the assumption of non-identity. This ratio can be treated as a measure of the probability of chance coincidence. Mathematically it can be shown that  $\lambda$  varies between 0 and 1 just as does the probability values, and in its interpretation the smaller its value the more positive the identification.

This likelihood ratio is one of the statistical means of testing a calculated value derived from a statistical sample. Naturally, in every handwriting identification problem we are dealing with what could be described as a statistical sampling of a person's handwriting when we use a limited set of known writing specimens as standards. Applying this likelihood ratio as described by Olkin in effect is a test to determine whether the probability of identity and probability of nonidentity are really significantly different and also gives us an estimate in a numerical value of this difference. Going back to our problems already discussed, in the first example of 10 factors with individual probability of  $\frac{1}{2}$  each we find that the likelihood ratio of the probability of identification divided by the probability of nonidentification is equal to 1. A factor of  $\lambda$  approaching 1, much less 1 itself, is a warning of an extremely weak identification. Let us consider the second case where we found that the probability of identification was approximately  $\frac{1}{99000}$  and of nonidentification approximately  $\frac{1}{57}$ . This gives us a likelihood ratio in round numbers of  $\frac{1}{4100}$ , a far more conservative estimate of the likelihood of chance coincidence. This procedure of Olkin's is certainly to be recommended as every identification expert, handwriting or otherwise, needs to be conservative in arriving at an identification.

### ***Need of Research***

Resorting to mathematical measure of the likelihood of accidental coincidence in the courtroom today is uncommon. Possibly under cross-examination the expert witness may be forced to do so by an opposing attorney. Under such circumstances he would, based upon his experience, state conservative values for the likelihood of occurrence of each characteristic, say one in ten, one in twenty-five, and the like (10). By multiplying together a series of ten, fifteen, or twenty such probability ratios he would establish a joint probability value sufficiently small, perhaps one in several million or billion, to justify his identification. Undoubtedly, under these circumstances no attempt would be made to apply the likelihood ratio just discussed, but even if this could be carried out on the witness stand a very small probability value would still be reached.

What is wrong with this procedure? Simply we are substituting an arithmetic guess for our original judgment of when we have made an identification. Granted through our experience we are able to estimate the frequency of occurrence of a particular identifying habit or quality with fair accuracy. Nevertheless, it is merely a guess based upon experience. What is needed if we are to avoid this situation is extensive research into the actual frequency of occurrence of various identifying factors. This requires a study of a large representative sample of handwriting. When we have completed it we would know that certain letter forms appear once in every ten North American handwritings. A very skillful writer is found in one out of eighty writers and so on. Periodically the study would need to be up dated to compensate for the effect of changes in handwriting instruction and use. Nevertheless, while the basic study must be extensive it is essential if one is to measure quantitatively the accuracy of an identification.



## ***Effect of Limiting Number of Characteristics***

In measuring the accuracy of any identification by means of probability determination we must remember that there are many identifying attributes in each on the problem. To achieve some simplification in determining a joint probability value only ten to twenty identifying characteristics may be used and the rest omitted. What results from such procedure? This question has already been touched upon, but should be given some further study.

In the discussion of this paragraph we presupposed that a tentative identification has been made and that a thorough search has been carried out for any identification factors which might invalidate our conclusion. In other words we are endeavoring to measure the accuracy of our identification and not using a joint probability value solely for the purpose of deciding when to quit looking for any points of similarity or dissimilarity.

If in our calculations we limit ourselves to only part of the writing habits and qualities present our final probability figure will be greater than the true value. If the likelihood of accidental coincidence calculated from fifteen characteristics is one in five million and if we were to include further factors we would only increase the size of the denominator making chance duplication appear less than less likely. Even referring to the likelihood ratio which was proposed earlier additional factors should likewise decrease the value obtained. Omission of a significant difference, however, is a serious situation. To include it voids the identification, to leave it out gives an incorrect answer (a figure of 0 in the multiplication chain gives a 0 product, that is  $\frac{1}{2} \times \frac{1}{2} \times 0 = 0$ ). Recognizing this one situation we can arbitrarily calculate the probability based on only certain factors and need not worry about some of the more complicated ones that have been discussed in this paper. It would seem that only in instances in which there is a very limited amount of writing in question, say the insertion of two or three words, that it would be necessary to consider every identifying element present.

Before undertaking the discussion of the last paragraph we were careful to establish an identification based upon a thorough and complete examination. Certainly there are those who would argue against this need since after a number of identifying factors have been considered the joint probability value or the likelihood ratio might well define an identification. This could, however, result in the dangerous practice of looking only for points of similarity and stopping as soon as identification seems reasonable. Handwriting cannot be identified in this manner, there must be a constant search for any evidence which would lead to a contrary conclusion, and only after a sufficient number of identifying factors have been found to substantiate and none have been found to contradict it are we safe in expressing an opinion. Superficial examinations can only lead to error. There is, therefore, a danger in using a limited number of identifying characteristics in a probability formula if the joint probability factor or likelihood ratio is going to serve as the sole means of establishing the identification.

## ***Conclusions***

What can be gained by the application of the mathematical measure of probability in handwriting identification problems? The greatest value is a concrete measure of the sureness of an identification. When the examiner states that in his opinion two writings were written by the same person he has actually applied the theory of probability (without mathematics). He has determined from his experience that the chance of accidental coincidence, that is that there



are two writers with these same writing characteristics, is so slight that for all practical purposes it can be disregarded. The value of using mathematical measure only leads others to appreciate the degree of accuracy of the identification.

At the same time if we assume values for the identifying factors, we only add window dressing to our opinion. We are not making our conclusion any more scientific or accurate by resorting to mathematics and the theory of probability. It is merely a tool to assist us in our estimation of accuracy.

Despite statements by some critics of modern handwriting identification methods, mathematical determinations based upon complicated research and calculations would add very little to the experienced examiner's opinion. With the beginner it might be a dangerous tool, causing him to stop too soon in his examination before he had exhausted his search for all identifying characteristics and thus gradually form a habit of careless, too rapid examinations. It is only in the very rare case involving limited amounts of writing that these determinations would have great significance. An opinion which considers and evaluates all of the identifying attributes present in the writing, if properly carried out, is accurate whether the examiner turns to a probability check on it or not.

### REFERENCES

1. Conrad Rizer, *Police Mathematics*, Chas. C. Thomas, Publ., Springfield, Ill. (1955). Chap. VII Permutations, Combinations, Probability, pp. 48-55 and Section 95, pp. 94-5.
2. A. S. Osborn, *Questioned Documents*, 2nd Ed., Boyd Printing Co., Albany (1929) pp. 330-40, 348, and 350 including footnotes.
3. F. E. Inbau, *Cases in Scientific Evidence*, Northwestern University School of Law, (1938) *People v. Risley*, 214 N.Y. 75, 108 N.E. 200 (1915) pp. 50-52.
4. P. L. Kirk, *Crime Investigation*, Interscience Publishers, New York (1953) pp. 475-6.
5. C. E. O'Hara & J. W. Osterburg, *An Introduction to Criminalistics*, Macmillan Co., N.Y. (1952) Chap. 46, "Probability and Proof", pp. 666-79.
6. A. M. Mood, *Introduction to the Theory of Statistics*, McGraw-Hill Book Co., Inc. N.Y. (1950). Chap. 5, "Expected Values and Moments" and especially Sec. 5.4, Formula 4.
7. Mood, Chap. 4, "Distributions of Continuous Variates" sec. 4.3, "Multivariate Distribution". Also: M. E. Monroe, *Theory of Probability*, McGraw-Hill Book Company, New York, 1951, especially Chap. 3, "Joint Distributions". Other sections of this text are extremely helpful in understanding the mathematical basis of probability determination.
8. Ingram Olkin, Ph.D., "The Evaluation of Physical Evidence and the Identity Problem by Means of Statistical Probabilities", a paper read at the General Scientific Session of the American Academy of Forensic Sciences, Cleveland, Ohio, February 28, 1958.
9. Mood, Chapter 12, "Test of Hypothesis", section 12.5, "The Likelihood Ratio Test". R. A. Fisher "On the Mathematical Foundation of Theoretical Statistics", *Philosophical Transactions of the Royal Society of London*, Series A. Vol. 222, discusses the likelihood ratio under this terminology on page 326. An elementary discussion will be found in J. Neyman, *First Course on Probability and Statistics*, Chapter 5, Holt, 1950.
10. Wilmer Souder, "Merits of Scientific Evidence" (*Police Science Notes*) *Journal of Crim. Law & Criminology*, Vol. 25, pp. 683-4 (1934-5).

## Discussion of Mr. Hilton's paper

HEAD: We are expressing a probability without mathematics when we make an examination and express the conclusion that in our opinion this individual wrote this writing. I believe you said that under cross examination if you were asked, "What is the probability" you would consider it then and assign a value of say, one in two for each feature. . . .

HILTON: I was quoting from an earlier paper of Dr. Souder. I think that you would be justified in evaluating from your experience the relative infrequency of the occurrence of these different factors. In other words there would be certain things that you would use in your identification that you might consider would occur only once in every 100 handwritings, some might occur once every 5 or 6 handwritings and you would assign the values like that.

HEAD: The point I am making is that you are being more than fair when you give them values of one or two.

HILTON: That is correct, yes.

MCNALLY: In line with some of the thinking that Mr. Hilton gave from O'Hara and Osterburg's book "Criminalistics" the feeling of Osterburg (Osterburg is the chemist and O'Hara, who did all the mathematics, is a physicist), is that the use of mathematics to prove anything in forensic sciences is fraught with danger and particularly in the use of mathematics to prove any proposition of identification in handwriting. O'Hara also goes along with him on this. I remember out in Cleveland, Dr. Weiner, toxicologist from New York also pointed out the extreme dangers of using mathematics to prove any proposition advanced by an expert witness in criminal science.

MCCARTHY: I think that the basic difficulty in probability is where you have the chance that an event might be duplicated, such as in handwriting, one chance in ten million, say that it can occur anywhere in the ten million. In other words this may be the one case in the ten million possibilities that it has been duplicated.

HODGINS: It seems to me that the greatest difficulty here is going to be in arriving at local probabilities. No matter in the light of your experience or even of a survey, be it of Canada or United States or practically world-wide when you actually go to Court you are going to a given area and the writer you are dealing with was, in some of our cases in the outports let us say, schooled and raised there as was everyone else and what may seem to be a reasonable and very safe probability otherwise is much too low for that area.

HILTON: I will thoroughly agree with that, that these determinations are going to be influenced as they would in this case by local training. Any factors that are determined and developed this year and years from now, even if you were to take them for the whole of Canada or the whole of the United States or the whole of the North American continent, should be revised or checked ten years from now, simply because of certain changes in the population, new writers coming in, old ones dropping out, which are going to change some of these values. In a particular area a more remote, rural type of area or where you have a very constant population where all people have grown up in the same school system and imitated each others writing to a certain extent, you are going to have some unusual factors there that are not at all unusual for that particular population.

HUBER: I take it Ordway, that you do not agree with the writings of the chap who said with respect to handwriting that you could place a figure of one in five on any given characteristic and that the average probability would be at least this.

HILTON: I certainly would subscribe to that. In many cases, you would be on safe ground but you might have one case in which you were dealing with a number of rather common habits in writing and you would need a lot more than the number that would be necessary in using the one and give factor to make your identification sure if you were trying to measure it with probability.

WRENSHALL: There are in my estimation two considerations which must be measured and calculated statistically. One of them is the frequency with which the particular characteristic under study occurs in any individual's writing, that is to establish its inherence, and secondly the frequency with which it occurs in many persons' writings, that is to establish its individuality. If you can do that, and I believe that it is not impossible, we are really getting somewhere.

DUKE: Am I right in pre-supposing that the discontinued product function assumes that all the separate probabilities are independent.

HILTON: O yes, all of them have to be independent.

DUKE: Dr. Olkin pointed out in his paper in Cleveland that this is one of the major dangers into which we could fall in attempting to compute a probability for firearms or handwriting identification. There is no guarantee that one event is independent of another. In the matter of form of handwriting there is no guarantee that because a person, say, loops the staff of his "d", that this does not also mean that thru some physical organization that he is going to make a straight staff under the lower loop of the "g", for instance, and this matter of independence is something that would have to be given serious consideration in any attempt to compute a statistical probability.

HILTON: Yes, that is one of the reasons why his approach has a certain appeal to me and while I have not been able to sit down with him long enough, he did see this paper of mine and offered his suggestions on it to clear up a few points in his own presentation that I was not able to get from my notes. He is comparing the probability of non-identification with the probability of identification and so if you have some non-independent factors in one you are going to have the same non-independent factors in the other, and they should to some extent clear each other out of formula. There is some advantage in that. As I said originally, it was a good conservative way of doing it but he said he did not propose it because it was conservative but because it was a valid mathematical way of doing it. We should always keep in mind that because we come out with some figure that this can only happen by chance once in any given number of times that this is no guarantee, as some one commented before, that this is not going to occur the very next time. What it merely says is that it is extremely unlikely that this will happen.

## Panel Discussion "C"

October 30

Members: Messrs. Hilton, Hodgins, Purtell, Smith.  
Moderator: Mr. Headrick.

### Topic: "Scope"

*Question (1):* **How broad should be the scope of the Document Examiner's services?**

PURTELL: I would like to break the scope of document examination down into say six categories. First would be the identification of handwriting and handprinting. Second, the identification of mechanical impressions. Third, the handling of burned, charred and torn papers. Fourth, the restoration of erased or obliterated writings. Fifth, inks and sixth, paper. Insofar as the scope of it, you have to set some limits depending on the ability of the examiner and his background in regards to how far he can go into inks or paper or mechanical impressions.

HILTON: There are certain problems that I would only hit the surface on among the things that Mr. Purtell had listed, principally in the field of paper, and not too deeply into inks either, but maybe more deeply than I realize. However, a private examiner such as myself has to handle what comes to him. Sometimes you can tell people that you can only do preliminary work in a particular field if it is something very unusual, but with a lot of problems you have to do the best you can. I would say the first five things that Mr. Purtell listed here would cover the types of examinations that I would generally undertake with the hopes of arriving at something definite. In the field of paper, I do limited work and generally I try to see that some paper expert is engaged in the case too.

SMITH: In my position I am obliged to take whatever comes in. I have tried to delve into, to some extent, all the problems that come in to me because there are no other facilities available for a long time. I do not profess to know anything about paper making, paper analysis or inks, but men engaged in this work do dabble in it to some extent. Whether or not they should reject it depends on the individual examiner and what facilities are available to him. More than 85 per cent of the cases are handwriting identification and I do not believe more than 5 per cent are typewriter identifications. Naturally, most of the work of any document examiner will be devoted to handwriting identification and that is where most of his studies and most of his activities should concentrate. If in taking in the other aspects of questioned document examinations that do involve paper and ink, it means that you would have to devote 95 per cent of your available time to do 5 per cent of the work then I think the comments of Dave Purtell apply.

HEADRICK: Mr. Hodgins, do you sometimes think that certain investigators or clients are hindered by the examiner accepting cases in which he cannot make a complete and satisfactory examination in connection with such things as ink and paper?



HODGINS: I think that is quite possible, I would like to take exception to Mr. Hilton's remarks, that a private examiner is forced to extend his scope against his wishes for it seems to me that the private examiner has a better chance to tell his clients where to go. We in the Government service have, I feel, an obligation to Her Majesty to attempt, that is our purpose, to deal with any matters concerning the document field. There is this sort of thing that I choose to call a creeping disease. Problems may come to us which we feel are a little out of our line but the first problems are often the simple ones and we tend to tackle them but by so doing we advertise ourselves in fields that we cannot consider ourselves qualified for. It is not that we should not be doing these things, it is just that we must be constantly striving to better equip ourselves.

HEADRICK: Do you think that by attempting to take on a wide range of work the examiner is doing more harm to the profession than by limiting his field of activities?

SMITH: If he has a natural bent and interest and does so for his own advancement and information and for his self improvement I do not see that he does any harm unless he prevents the proper and more qualified person from making the study that should be made. If there is such a person available then it ought to be sent to that person.

*Question (2):* **Are examiners currently tending to extend themselves beyond reasonable limits?**

PURTELL: I think that by extending yourself past what you believe are your own limits you are not only going to hurt yourself but the whole profession. In listing the six phases of document work, I did not intend to indicate that I cover all phases of paper identification. There are times as a document examiner you can do more good to a case helping the investigator with the aid you can give him than by going into Court and trying to fight out a very technical question on the identification of paper.

SMITH: When I accept a case I am inclined to look at it as a whole investigation and if there is anything that I can contribute to it that will facilitate the investigation that I do, I do not mean to imply that I would go into Court on a lot of these side lines like paper making, but you can sometimes see certain things that are investigative aids. They should be developed by the man who has the material in his hands but as far as pursuing it for court purposes, if there are other experts, then it most definitely should go to a specialist in that particular line.

HILTON: Mr. Hodgins may have misinterpreted my statement, I did not mean to say that I pursued these things because I was pushed by clients but I feel as a private examiner I should equip myself to do as extensive work as I can in the different fields. Whether examiners are currently tending to extend themselves beyond reasonable limits is an individual judgment factor in many cases. Mr. Hodgins said he thought we could tell our clients where to go and there are two ways of telling them that too. Many times when a client wants certain things determined, and people have all sorts of ideas of what could be done, I discourage him from employing me simply because I feel that what could be determined as far as my knowledge is concerned is of little value. Sometimes he employs me anyway but that is his business, he has been advised.

HODGINS: In submitting some of these problems to other specialists we could fall into habit of limiting ourselves unduly. Instead of worrying so much about finding specialists who can do this, we should be preparing ourselves to do it. In making the remarks that private examiners have the opportunity to tell people where to go I did not altogether mean it the way it seems to have been taken. I meant, what specialist to go to.

HILTON: That is entirely true. We should equip ourselves to know where the answer could be found if it requires highly technical information, even though it might be related to questioned document work. Both civil or private examiner and the laboratory examiner could well do that, and I think many times the laboratory should go outside of its own confines to get a particular specialist to assist them in some extremely difficult and highly technical phase of questioned document work.

HEADRICK: Do you believe that in these cases the examiner should more or less direct the activity of the specialist or assist him in the case?

SMITH: This business of referring things to other people to work on is very hazardous. We all know about the matter of taking care of evidence. Referring your documentary evidence to someone else can prove more harmful to the document than helpful on many occasions. You would have to control what was done on it.

PURTELL: In our laboratory procedure we handle anything in the five or six parts I listed at the start as the work of the document section. It is cut and dried which section in the laboratory will work in a particular type of evidence. I might explain that of late the laboratory is going outside our own walls and has set up working relations with the larger museums in Chicago, the Universities and some of the big industry in Chicago. When we cannot obtain an answer we can call on these highly specialized people in a particular field like petroleum products, Standard Oil of Indiana, Harmer Research Foundation and the Illinois Institute of Technology. We have been working out quite an extensive program by which we can obtain information from outside our laboratory. So far I have been able to handle all the problems which have come into the document section, but I am using the other sections of the laboratory to show what we have done to extend their facilities

## Questions from the floor

SOMERFORD: I would like to ask the panel whether they would include a good knowledge of documentary photography as part of the basic requirements of the qualifications that are necessary for the scope of the document examination work.

HILTON: I definitely would, because I feel that so many problems depend upon good photography for proper handling. I do not think you can farm that out, unless you are in a laboratory situation where you have trained photographers who know the wishes of the document examiner and what he is attempting to do. Like many other aspects of questioned document work there will be some particular person in a larger laboratory who may specialize in some particular phase; a photographer might do any kind of photographic work but he would be a document photographer, but I do not think that the private examiner is doing his full job if he is farming out photographic work

GODOWN: I think it is very wise, if the examiner does not have his own photographic ability to make first class photographic exhibits that he should by all means be present when they are made by a capable photographer so

that he can properly introduce them in evidence. He should be able to say I did the photographic work myself or it was done directly under my supervision, because in many jurisdictions you cannot introduce photographs unless you can give the technical background of their production and a man that does not know photography might well end up with exhibits that he cannot talk about. It is necessary to recognize your limitations. It is bad to go to court with poorly made photographs and one should be intelligent enough to recognize when he should get expert help in doing something that he himself cannot do or when he needs the specialized equipment of some large laboratory.

DUXBURY: Should a laboratory, if they do have a sufficient staff, specialize their members in, say, typewriting so that any typewriting problem is given to a particular man who goes to court in all the typewriting cases?

HILTON: I think that in a laboratory where there are several examiners working together that a great deal of benefit can be derived by each man having certain things in which he specializes, not to the extent that the others know nothing about it or cannot handle a problem in the event of his absence or prior occupation. Certainly then you are in a better position to handle the more difficult problems. There are certain men in private practice that are known as having done a little more work or paid a little more attention to some particular phases of questioned document work and many times in important cases it is possible for us to recommend that the other men's services be engaged in addition to our own so that this one particular specialty can be properly developed in the presentation of the case.

COLE: It seems to me you cannot divorce the idea of scope from the idea of the questions asked about a document. In other words, if the question is "Is this document genuine?", or "Is it forged?", or "Who wrote the stuff?" "Does it need special validation?" or something of that sort, then the document analyst has a duty to accept the question, without considering at that very point just what techniques he might have to bring to bear on the whole problem. It could very well be however that after fully considering the problem that he would write a report in which he would say, "There is nothing in my experience which will contribute a solution to this problem, however, in my opinion I think that a determination whether or not this sheet of paper is identical to a certain other sheet of paper may advance a solution to the problem". In other words, I feel that the document analyst should in most cases when there is a question about the genuineness of the document take control of the case.

DUXBURY: We instruct and recommend that any exhibit of a documentary nature be submitted to the document section prior to any other examination and this applies particularly to fingerprint examination. I think the document examiner is the person in the best position to assess what other specialized examinations could be undertaken.

HILTON: Mr. Cole has a very good point. I am thinking particularly of a problem that frequently comes to those of us in civil practices, that is the question of the age of a document. People have the idea that you can always tell the age of a document, but most times when you look at the document you realize it is almost hopeless to try. But I have found in so many cases that some examination of the whole document will disclose that there is something in the document that may actually answer the question without going at it the way that it was presented to us. It is one of the dangers in too much specialization in the laboratory where you have several examiners, that each

one does not become so specialized that he does not realize the full scope of the work. There are many facets to document examination and we must recognize what things might be done even if we personally cannot do them.

SOMERFORD: I think the services of the laboratory man can be more effective by having a good knowledge of all these specific subjects that we have mentioned as being essential or desirable. I think one can carry the case to a better conclusion, whether he has a typewriting problem or a handwriting problem by going into Court and covering the different phases simultaneously rather than sending two or three specialists.

HUBER: I think the panel has pretty well covered in detail the scope of the work of the examiner and the matter of control and preservation of the evidence, which I feel is something that we as document examiners, and people that are constantly going before the courts, have a greater appreciation for than many of the specialists which you might engage or recommend to a client or an investigator to assist them. It is, I feel, very important as Mr. Smith points out that the evidence must be preserved and handled in a certain fashion. It is for us all to realize that while we might exercise control or advise as to how document matters might be handled, particularly when they do exceed our limitations, there is a danger of extending ourselves which we must be constantly aware of and if we are constantly aware of that danger and use our intelligence there should be no trouble arising out of the problems that we do consider. I think we have to accept pretty well many of the cases, if not all of the cases, because it is not until you get into a case that you can really determine just the nature of the work that might be done on it. You are thereby involved in the matter to some extent. There is I feel a tendency for people having gotten so involved to try to work their way out by going as far as they can and this may lead us onto dangerous grounds. There is also another factor that we have to consider and that is that in many cases the qualification of the document examiner is based on the experience drawn from the work on a great number of such cases and the ability to handle the next case will depend on the number of and the diversified experience obtained in previous cases. But we must be constantly aware of the dangers, the thin ice on which we can only too readily tread.



## Questioned Document Studies in Officer Training

ALWYN COLE

U.S. Treasury Department  
Washington, D.C.

In the book of Ecclesiastes of the Old Testament, it is said, "That which has been is that which shall be, and that which is to be done is that which has been done." This preacher, for the most part, gives a dark picture of life, but I find this particular statement a happy one for the document analyst. The knowledge that what has been is that which shall be is the reason we pay close attention to books that relate a lifetime of experience with questioned documents, such as the books by Ames, Osborn, and others. This statement reminds us that if the forger gives us information about his habits of today, we can by close study of them predict what he will do in the future and thus we can expose his frauds and bring him to justice. The same statement shows why much of what you have heard thus far in this Seminar you will hear again—and I believe it deserves repetition. Finally, this statement gives the real mathematical basis for judgments about documents, which is the repetition of a large number of instances and the discovery that the experience they give is consistent. Each new judgment must be compared with a base of experience that includes a large number of cases of the same class. The great advantage of the frequency theory of probability is that it enables us to make a continuous judgment to distinguish the more probable from the less probable.<sup>1</sup> All of you have known a new day at dawn some ten thousand or more times. This authorizes you to say with great (but not absolute) certainty that the Sun will rise tomorrow. I have a feeling of great satisfaction in the knowledge that the frequency theory of probability has been applied and tested from the time of Ecclesiastes to the present and will continue to be tested. This theory is like a living organism that has the ability to discard a worn out cell or disproved hypothesis and continually adds new cells or information.

The service for the examination of questioned documents began in the United States Treasury Department in a formal way in the year 1913 when Mr. Bert C. Farrar, formerly an official of the Sub-Treasury in St. Louis, came to Washington to help organize a new division in the Treasurer's Office concerned with the payment of checks drawn by government disbursing officers all over the country. Mr. Farrar had already gained experience with questions about detection of forgery, detection of erasures, alterations, and counterfeiting, and identification of handwriting through his work in the Sub-Treasury and by independent studies. In Washington he found new and more varied opportunities for adding to his experience as Government services began to broaden, reach more people, produce more records and therefore produce more questioned documents. Mr. Farrar was the first Examiner of Questioned Documents in the Federal Service. At that time he accepted work from all other Government Departments. I became associated with Mr. Farrar in 1926, and shortly thereafter I began an apprenticeship under him.

The Treasurer of the United States is a charming and competent woman by the name of Ivy Baker Priest, appointed to that office by President Eisenhower. The chief duty of the Treasurer is to care for public money. The

<sup>1</sup> Morris R. Cohen, "A Preface to Logic".

Treasurer must give a receipt for money coming in and provide physical safeguards for it, and must secure a good receipt for all money paid out. The task of obtaining a receipt is accomplished by issuing and paying Government checks. I have had the experience of beginning a conversation with an acquaintance by saying, "Did you know that the Government issues and pays about 400 million checks each year?" and it is not uncommon to hear the response, "What an extravagance! Why so many?" It requires only a moment of reflection to understand that each check represents an economy to the Government (all except the forged checks, of course). If the Government did not have the convenience of taking care of its business by checks, it would have to do much of this by personal contacts. Dealing with people face to face is pleasant, but personal contacts are time-consuming and expensive, and they are often inconclusive. The Government check is a wonderfully efficient accounting form and receipt and it provides a good substitute for personal contacts. In a sense, a document, such as a check, note, affidavit, letter, stands for or represents a person. We vastly multiply our ability to deal with people by dealing with documents in their place. This means that documents must be kept honest. Happily, the great majority of them are honest, but among these millions of checks some are forged, or altered, or otherwise wrongfully handled, and they become questioned documents. The number wrongfully handled is only a small fraction of one per cent but when you apply this small fraction to 400 million there are enough to constitute a big investigative job for the United States Secret Service whose duty, among others, is the protection of Government obligations, and these forged checks constitute an important administrative job for the Treasurer, U.S., to see that payees get duplicate checks, that money is recovered from banks, and that disbursing officers observe safe practices in writing and delivering checks. There is a common interest on the part of the Secret Service, which is a Division of the Treasury Department responsible to the Secretary of the Treasury, and on the part of the Office of the Treasurer. The Secret Service suppresses forgery. The Treasurer takes care of the rights of payees and banks, and maintains accounts for several thousand disbursing officers.

From the beginning of the establishment of the service for the examination of questioned documents in the Treasurer's Office it has been the custom to make this service available to the whole of the Treasury Department. Naturally, the law enforcement agencies of the Treasury found the largest number of instances for using this service. This wide base for the receipt of work means that experience gained by working on a problem submitted by the Bureau of Narcotics or by the Internal Revenue Service can be put to use on problems submitted by the Secret Service or by the Treasurer, U.S., or any other. The benefits of this interchange of experience flow in all directions, since the chief tool of all document analysts is experience in the work. The flow of work from which the document analyst draws this experience must produce a variety of problems for a well-rounded experience, and must produce a repetition of problems of the same kind to aid in the establishment of principles. Our purpose is to bring the lessons of experience with a large number of documents to bear upon the solution of each individual problem presented by a single document.

The Treasury Department not only produces a great deal of important paper of its own, checks, currency, and bonds, but the Treasury has a legal interest in a vast number of records maintained by citizens and business firms. *The Bureau of Customs* is interested in records of import and export. Even the commonplace customs declaration made out by a tourist may become a questioned document. *The Coast Guard*, which has law enforcement responsibility over United States waters and must provide for port security in screening merchant seamen and others, is often concerned with the genuineness or

identity of documents. For example, "Is this seaman carrying a genuine or a forged identification card? If the latter, is he a subversive agent?" The *Secret Service* responsibility for protection of currency, checks, and bonds, is only one of its several duties. The highly important duty of protecting the life of the President is well known. A plot or a threat against the President may produce questioned documents. The *Intelligence Division* of the *Internal Revenue Service* is concerned with the possible evasion of taxes. Their special agents have the right to examine records kept by individuals and business firms, all of which have a potential for producing questioned documents. The illegal sale of narcotics or the smuggling of narcotics often produces records and these are of keen interest to the *Bureau of Narcotics* of the Treasury. The *Enforcement Branch* of the *Alcohol and Tobacco Tax Division* of the *Internal Revenue Service* is concerned with fraudulent violations of the tax laws affecting the products included in its name and in addition has the important duty of enforcing the Federal laws that control traffic in weapons such as machine guns and machine pistols, to prevent their reaching the hands of criminals. When you have manufacture and sale of avidly sought products such as alcohol, tobacco, and firearms you are bound to have a vast number of records and any of these may become a questioned document. For example, a sales slip showing the purchase of a large quantity of sugar may indicate plans for setting up an illegal still for the manufacture of alcohol.

One noteworthy feature of the work of law enforcement officers of the Treasury Department is their concern with the information given by documents and questions about the genuineness and identity of documents. Hence, we have specialists in the Treasury Department who spend their full time in the critical study of documents. The most frequent questions are: "Is it genuine?" "Has it been altered?" "When was it made?" "Who made the document?"

It is not enough to have only specialists doing this work. For one thing it might take a week or so to bring a case to his attention, but the investigator might have to make a decision based upon a document a few minutes after seeing that document for the first time. If you asked the specialist all possible questions about documents you would so encumber his time that he would not be able to devote sufficient attention to a matter of great importance or urgency. Moreover, the investigator should be able to ask significant questions about documents—questions that will bring forth information useful in furthering his investigation or useful in the prosecution of a violation of law. The responsibility for asking significant questions carries the responsibility also of collecting appropriate standards for comparison.

With these problems in mind the several enforcement agencies of the Treasury Department have included in the combined training school for Treasury Law Enforcement Officers a section dealing with questioned documents. The coordination of these enforcement agencies in training and many other matters is done by the Assistant to the Secretary for Law Enforcement, Mr. Myles J. Ambrose. The School set up by the encouragement of that office made noteworthy development under Mr. Robert I. Bouck of the Secret Service and the School has shown further development under the able administration of its present director Mr. Patrick P. O'Carroll of the Bureau of Narcotics.

Each of the forty instructors in this School, who are all operating employees actually working at the specialties they teach, has a common problem. This problem is that there are 39 other instructors who are making a demand for the attention of the students. During the time these students are concerned with constitutional law, search and seizure, rules of criminal procedure, arrest and handling of prisoners, conduct in court, report writing, and many other subjects, I have four hours—one afternoon on one day of their schooling—



to try to bend the energy and attention of these men to problems about questioned documents. In these circumstances an instructor is justified in making a strong appeal for attention. His methods may not be those that would impart the greatest amount of information in a short period of time but they should be methods that will make a lasting impression. As a practical matter the instructor is obliged to set a somewhat limited objective—one that he would have a reasonable chance of reaching. Our objective is first to inform the students of the kind of help the laboratory is ready to give; to inform them of the kind of material we need from them in order to give this help. And, most important, to encourage the students to improve their ability to make useful judgments about documents during the active phases of an investigation. We urge them to do this by making the best use of their experience with documents. We urge them to study documents with an awareness that each one has a lesson to teach.

I should like now to present for your consideration some of the instructional methods used to gain attention, to impart information, and to encourage study. I would appreciate your comment about effectiveness, or your suggestions for modifications. What I say from this point on are sections from the material that I would present to my class.

You must be interested in a thing in order to see its significant features. No doubt you know of many examples of the truth of that. One that impressed me gave an answer to a question that I thought might never be answered. The question is this: If a counterfeiter should be able to assemble equipment, materials, and skills equal to those used by the Government would he be able to produce a counterfeit that would defy detection. Let us say that in this hypothetical example the counterfeiter would have the best equipment and materials, and all necessary knowledge and skill but, like most counterfeiters, he would use a photo-mechanical method of reproduction rather than the original preparations of engraved plates. When the U.S. Government announced some years ago that it would print certain bonds by offset lithography rather than from engraved plates, it seemed we would have an answer to this question. When these new bonds appeared it was clear that a most exacting attempt had been made to produce by offset lithography the identical product secured by printing from engraved plates. The results were close but not perfect. Now, I show you an example of printing from engraved plates and another example of printing by offset lithography. Both are genuine, both produced by our Bureau of Engraving and Printing with an effort to make them identical. But there are significant differences, and if you believe that this problem is interesting enough to warrant spending just a few moments in studying the two examples, you will see the differences. You will then have a demonstration that you have the essential equipment for making useful judgments about documents; namely, the ability to see and interpret very small detail.

A student will sometimes object to formulating a plan for improvement of his judgment about questioned documents by saying that there is little lesson-teaching material to work with. While he is aware that a forgery might confront him in his work at any time, he does not see enough forgeries within a short period of time to help fix in mind some of their common features. To that objection I say: You can be sure that the forgery when you encounter it will always deviate in some significant way from genuine documents. Therefore, a detailed and thorough familiarity with genuine documents will give you an excellent tool for detecting these deviations. Do not wait for the appearance of a suspected forgery to begin the study of documents. You can begin right now with the most commonplace material.



I hold in my hand a number of items of direct mail advertising matter. I suggest that even by studying this kind of material you can make observations that may later have a useful application. This letter (holding an example aloft) was printed from raised type but the type was not inked directly as in letterpress printing. Instead, there was stretched over the entire surface of the printing plate a closely woven inked ribbon. We know this because we can see a regular pattern of the weave of the ribbon between words and between lines in the form of discrete dots of ink. Such a pattern may be seen in the body of a typewritten character but rarely between words. The presence of a pattern such as I have described belongs to a particular form of duplication. The other items in the material that I have here all show characteristics belonging to the method of duplication, such as stencil, half-tone screen, gravure, multilith, letterpress, etc.

What I have to say next will make it appear that I have suddenly changed the subject, but stay with me a moment and I will show you a connection. For many years the Treasurer in dealing with altered or raised checks placed some reliance in the circumstance that when a check was altered the job was not usually well done. Although checks on which the amount had been raised passed through merchants and banks and even through some of the clerks in the Treasury Department who were supposed to detect the alteration, when the check was finally laid out alone for inspection we would usually have two questions. One was, "Why did anyone accept this altered check?" and the other was, "Why did not the forger do a better job?" There came a time, however, when the Treasurer gained some completely new experience; namely, alterations of the amounts of checks where neither of these two questions could be asked. You could not ask why did anyone accept this check; you could not see any reason why they should not. You could not ask why the forger did not do a better job—the alteration was highly deceptive. I hold here a photograph (Fig. 1) of the altered amount of one of these checks. Since you will not be able to see it in detail from where you sit, I will make a diagram here on the board. This amount reads \$483.57\*. When you know the method of accomplishing a forgery you are well on the way to detection of similar forgeries and I believe you will be interested in knowing how this alteration was made.

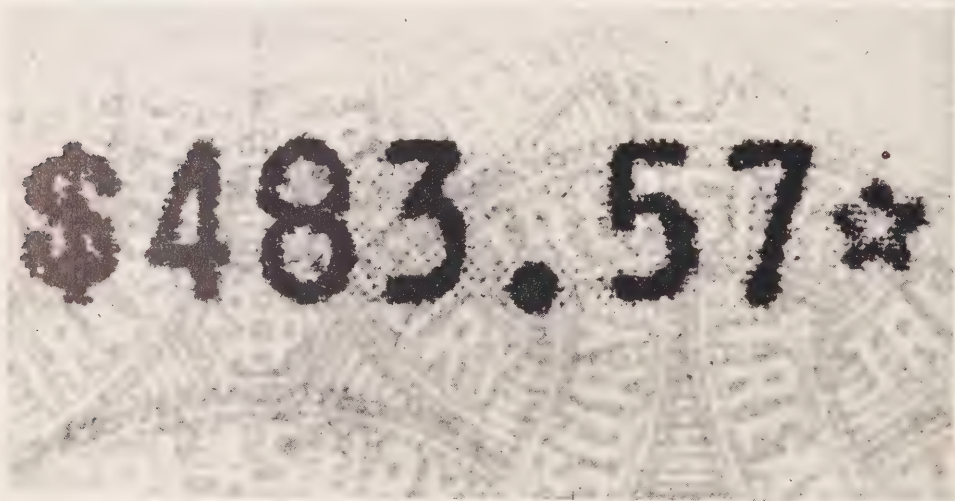


Figure 1

Where you see the numeral "8" there was once a dollar sign. The forger has cut the dollar sign out of the check. In making this cut-out he barely penetrated the skin of the check; there was no mark of the knife on the reverse side. The cut was made in the shape of the block outline of a figure 8. Then from some other check (probably one reserved for this purpose) he also cut out a block outline of a figure "8", barely taking the skin of the check, and he then transferred that part to the surface of the check to be altered. In other words, he performed an operation like a skin graft, removing the part blemished with the ink of the original dollar sign and inserting a clean blank section cut from another check. The work was done so carefully that the surface tint design was matched. Now the forger had a blank area to the left of the figure "3" that would differ from other blank areas of the check only in that it showed the marks of the knife forming the block outline of a figure "8". His next step was to draw in a figure "8" so placed that it exactly covered the marks of the knife. He then drew in a figure "4" and a dollar sign and as you see the amount reads "\$483.57\*". This particular form of check does not show the amount in words, nor repeated anywhere in figures.

I have not been entirely frank with you because I have not placed on this diagram everything that is shown on the photograph but I will now proceed to complete the diagram (adding pattern of dots in the area of "357\*"). Now we have evidence that the original printing of the genuine amount of \$3.57 was done through an inked ribbon stretched over the whole printing plate, not separately for each figure as in typewriting. As a consequence we have this pattern of regularly spaced dots around the *genuine* figures. There is no such pattern in the area of the *fraudulently* added figures. We have an item of evidence that is quickly susceptible of ordinary examination. This is important because such altered checks would turn up among hundreds of genuine checks so that there would not be time for the critical examination of each one under a microscope. They could only be separated by having a detail susceptible of ready examination.

Now you see that an observation about a characteristic of a particular method of printing that began with this casual piece of advertising matter has an important application to a real questioned document problem. Therefore, I repeat, do not wait for the appearance of a forgery. Begin your study of the characteristics of genuine documents now.

We are not yet finished with this advertising material. Each of these letters is signed with a facsimile signature. I mean a mechanically printed signature, not a personal signature made with pen and ink. Yet these facsimiles so well simulate a personal signature that if you should find one of them on a document that was expected to bear a personal signature you could very well be fooled by the facsimile. This indicates the need for a searching study of facsimile signatures in order to fix the differences in mind. Some of these differences are due to the circumstances that facsimile signatures are printed with a tacky ink that dries to a fairly hard film, whereas personal signatures are made with either a fluid or paste ink. The application of a fluid to paper gives a characteristic line quality. The use of paste inks as from ball point pens are also characteristic of that instrument.

Does the possibility of fraud by the use of a facsimile signature seem far fetched? Here is a photograph (Fig. 1a) showing two endorsements on a Treasury check. The first endorsement is a forgery; it was not made by the payee. The second endorser is suspected of having written the endorsement of the name of the payee or at least of having uttered a check known to bear a forged endorsement. But wait! this second endorsement is not a personally made

signature; it is only an impression from a rubber stamp. I do not know whether a person might escape liability for handling forged checks by use of a rubber stamp. We did not have to decide that question in this case because some other checks of the same series were signed with a manual signature and these could be proved to be those of the second endorser, who knew that the payee did not endorse these checks. It was of great importance for the Government's case to know which checks had a rubber stamp signature and which checks had a personal signature.

It is suggested that this check be promptly negotiated.

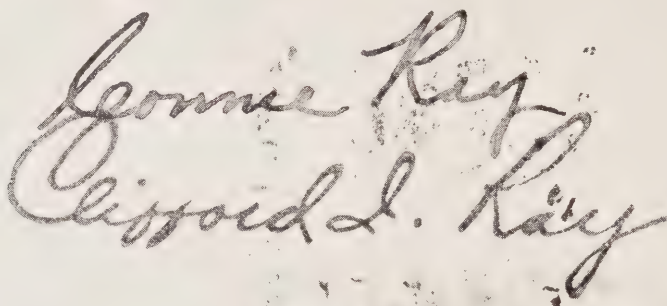
The image shows a handwritten signature in cursive that reads "George Ray". Below it is a faint, rectangular rubber stamp impression that reads "Clifford L. Ray". The stamp is significantly lighter and less distinct than the handwritten signature above it.

Figure 1A

The opportunities for making observations about documents are virtually unlimited and one need never despair that some of these will not be put to use. You have only to enjoy a long life and you will find that practically every item of information and knowledge will have its use. My interest in documents has led me to make observations that might seem quite idle if I had not had many examples of how an apparently obscure item of information would lead to a useful judgment.

Recently, while making a routine inspection of a document I noticed that a certain indelible pencil writing, having the familiar dull metallic lustre with an overcast of color for most of its area, yet had one small section with the bright purple color that is characteristic of indelible pencil writing that has been moistened. But, there was no evidence of application of moisture to the paper. Then I observed that near the purple colored section of the indelible pencil writing there was an impression of a rubber stamp. I knew that stamp pad inks contain glycerine; that glycerine is a hygroscopic substance, absorbing moisture from the air to keep the ink from drying on the pad. I reasoned that the glycerine had migrated in the paper and had thus reached the area of the indelible pencil writing, pulling in moisture from the air and causing the colored substance of the indelible pencil to coalesce—assume the nature of a liquid with its consequent bright purple color. I then prepared several samples of indelible pencil writing and made impressions of a rubber stamp near them. I withdrew these samples daily for inspection and in approximately two weeks of normally humid summer weather these specimens developed the same condition first observed. This example is only one of many that present an opportunity for



reconstruction—to bring together the materials and to create the conditions that are believed to have caused a certain effect in a document. Please observe that this experimentation is done independently of the document. You must NOT tamper with the questioned document in any way—not even by the addition of a fold or a pin hole. This would not be done even in the laboratory without special permission from all who are concerned with the document. But the materials of documents are always at hand ready to be combined in different ways for study of their effects and relationships. Recently my bank took all of the traditional nib pointed pens from the lobby (without consulting my preferences) and installed ball pointed pens. After these had been in use about three months I went through the lobby and took specimens from each of some 60 different ball point pens and I still have these and other specimens under study.

The number of workers with questioned documents is so small that anyone interested in the study must be on the alert for discovery of any principle, rule, general truth, admonition or precept that will aid him in discovery of the truth about documents. Here is an item of advice that came to my attention some years ago and I have had reasons almost daily for remembering it.

John Dewey says in his book "How We Think":

"One can think reflectively only when one is willing to endure suspense and to undergo the trouble of searching. To many persons both suspense of judgment and intellectual search are disagreeable; they want to get them ended as soon as possible. They cultivate an over-positive and dogmatic habit of mind, or feel perhaps that a condition of doubt will be regarded as evidence of mental inferiority. It is at the point where examination and test enter into investigation that the difference between reflective thought and bad thinking comes in. To be genuinely thoughtful, we must be willing to sustain and protract that state of doubt which is the stimulus to thorough inquiry, so as not to accept an idea or make positive assertion of a belief until justifying reasons have been found."

These words made a deep impression upon me but I believe this impression was the more pronounced because I happened to know of a case that needed just such a summation as that given by Professor Dewey. This example involved one John Edel (not his real name) who was charged with burglary at a particular day and hour in a large city on the West Coast. Edel's alibi at the trial was his signature on a hotel register in a small town several hundred miles from the scene of the crime. There was no question about the genuineness of the alibi signature but Edel was convicted of the crime. This was not a Federal case but was prosecuted under local laws. Apparently the jury heeded the argument of the prosecuting attorney that the signature on the hotel register should not be accepted as an alibi because throughout the area of the signature there was evidence of a disturbance of the paper fibres, indicating that some other writing had originally been made in this space and that Edel had contrived to cause its erasure and then to substitute his own signature on the hotel register, knowing that an alibi was needed. Edel began serving his sentence. Some years afterward, Mr. Bert Farrar, my predecessor in the Treasury Department was in the same city on the West Coast where this trial occurred and he was asked by the judge who heard the evidence to make an examination of the hotel register. Mr. Farrar confirmed the previous observations made by the prosecuting attorney in argument to the jury, that the paper surface was much disturbed as by a hard eraser or knife, but he also reported that Edel's signature was an original writing in that area; that no other writing had been erased. He pointed out that the evidence of erasure consisted of discrete islands and that not a single



mark of the eraser touched a line of Edel's signature. It was impossible to believe that any writing of any kind might have been erased in such a manner as to leave clear space through which Mr. Edel could wind his signature. It was clear that the marks of the eraser had been added to the document after Edel's signature. I believe you will agree with me that John Dewey's advice is good—we must be willing to endure suspense and to undergo the trouble of searching . . . we must be willing to sustain and protract the state of doubt which is the stimulus to thorough inquiry. The coming together of this powerful advice and the vivid example make a lesson that will always be remembered.

Another difficulty that all instructors have is that time runs out and as the end of a period approaches one begins to think of ways of concentrating much of what remains to be said into a short period available. It occurs to me that a way of doing this is to put together some questions and answers in the form of a sample cross examination. The law enforcement officer needs this kind of information because he must frequently represent the document analyst to the district attorney or attorney for the Government. He may be obliged to comment upon a report or say something about the method of presenting testimony.

The answers in the hypothetical cross examination to follow are not entirely practicable because some of them are too long; they would have to be given in response to two or three questions, but I believe such questions would come where there is a real desire for information.

- Q. 1. What you have said here about the defendant's connection with the questioned document is just your opinion, it is only your opinion, is it not?
- A. 1. My testimony is more than just an opinion. It is a reasoned judgment. It is an opinion supported by a statement of reasons and supported by previous experience with similar problems.
- Q. 2. Well, regardless of whether it is opinion or reasoned judgment, you would not say that the examination of questioned documents, more particularly the identification of handwriting, is an exact science, would you?
- A. 2. By definition there is only one exact science and the name of it is not the examination of questioned documents. An exact science is a mathematical science, or a science that permits an absolute precision in results, free from any possibility of error normal to human perception. Only mathematics comes close to satisfying that definition.
- Q. 3. Well, is the examination of questioned documents a science in any sense?
- A. 3. Yes it is. In the sense that it makes use of knowledge gathered by actual observation and experiment, classified, formulated, and verifiable, it is a science.
- Q. 4. Nevertheless, you said just a moment ago, did you not, that your findings were not free from the possibility of error.
- A. 4. The complete phrase "the possibility of error normal to human perception" was given in the discussion of exact science. When you mention possibility it is necessary to think of degree of possibility, whether it is a very close one or whether it is a mere possibility. I have made a serious attempt to evaluate the degree of possibility of error in my opinion, and I believe that it is only a remote possibility. It is not one for which I can assign a reason drawn from the documentary evidence in this case. It is not a possibility that is peculiar to the examination of questioned documents, but it exists in this field and in all other fields of judgment only because no human judgment is infallible.
- Q. 5. I believe you said a while back that your findings in this case have no mathematical basis.
- A. 5. I did not quite say that. As a matter of fact my findings do have a mathematical basis, although somewhat indirect.

Q. 6. Please state what that basis is?

A. 6. It is a statistical basis. It depends upon the fact that the documents involved in this case, about which I have testified, are similar to other documents examined in many other cases. The observations made about the documents in the present case are of the same quality as those made in other cases. In those other cases conclusions were expressed and there occurred later either a verification of the conclusions or an absence of contradiction where the circumstances would favor the development of a contradiction if there had been a basis for one. Inasmuch as this case is similar to a large number of other cases, the conclusion ought to be similar and that is the conclusion I have expressed.

This principle does not belong exclusively to the field of the examination of questioned documents but it is the same principle that governs practically all judgments and helps certify to their reliability.

Q. 7. Do you mean to say then that you have never been mistaken?

A. 7. I will say that to the best of my knowledge I have not been mistaken in any opinion given as testimony after the usual careful and exhaustive examination that precedes testimony.

Q. 8. Does that amount to saying that you have never made a mistake?

A. 8. No. I answered the question first with respect to opinions given as testimony. Opinions are given for many other purposes and they involve conditions not nearly so rigorous as those we insist upon before giving testimony. In some of those cases I have had occasion to revise, modify, and even reverse an opinion. If I should say that I cannot identify a suspect as a forger of a check when, in fact, he was the forger, that might be called a mistake.

Q. 9. Isn't it true that experts frequently disagree.

A. 9. I will consider your question to be limited to experts on questioned documents and I will answer with regard to all cases, whether handled in office, laboratory, or court room, of which I have personal knowledge, in which two or more experts have made examinations. Upon that basis I can say that among men that I know to be expert, disagreements are not frequent.

Q. 10. Well, let's forget about opinions given in the office and laboratory and confine our attention to the court room. Would you not say that when you have disagreement that the testimony then cancels out and that the court and jury can make no use of it on either side of the question?

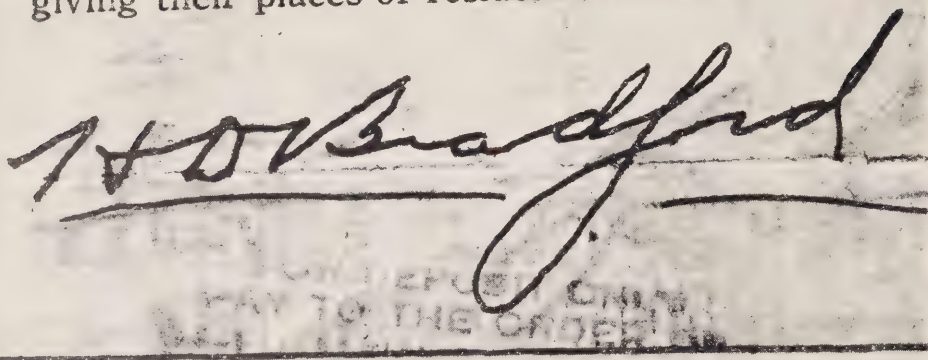
A. 10. By no means. Where you have a conflict in testimony, whether expert or any other, the same testimony usually reveals a basis for choosing which should be regarded as the truth. It is hardly ever possible to present reasons of equal force on opposite sides of a question.

Q. 11. Are you absolutely certain in the opinion you have expressed?

A. 11. I am not accustomed to use the term "absolutely certain." However, the term, if used, would have to be regarded as a summary of a body of evidence, and in that sense it is opinion or judgment. If the possession of satisfactory reasons for believing a thing and the absence of any reason for doubt may be regarded as a warrant for the term, I will say that I am absolutely certain; however, I am accustomed to say that it is my opinion and I have explained that as being a reasoned judgment.

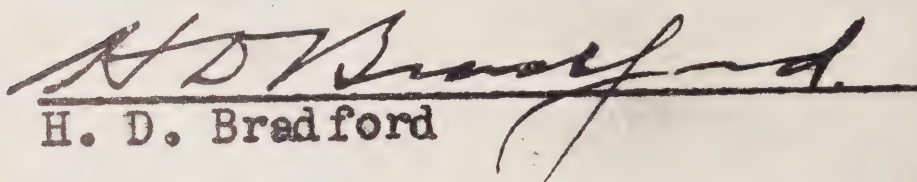
My instruction period at the Treasury School includes the showing of a number of photographic projections. Each is intended to illustrate a lesson, or axiom or caution. Sometimes these slides are shown in a series of three or four to give the progression or development of a theme or to show a rule and some of its exceptions. With your permission I should like to show some of these projections. The comment will be somewhat abbreviated in order to cover a larger number, but I should be glad to discuss any of them at greater length if you desire.

giving their places of residence in full.



The image shows a handwritten signature 'H. D. Bradford' written on a horizontal line. The signature is characterized by a very slow, shaky, and irregular line quality, with many small hiccups and hesitations, particularly in the capital 'H' and the 'd'. The ink appears dark and somewhat blotchy.

Sincerely,



The image shows a handwritten signature 'H. D. Bradford' written on a horizontal line. This signature is much more fluid and confident than the one above. The letters are well-formed, and the connections between them are smooth. The capital 'H' and the 'd' show a clear, strong down-stroke, indicating a rapid and controlled movement of the pen.

Figure 2

*H. D. Bradford*

Here (Fig. 2) you see a traced forgery on the first line and on the second line a genuine signature of H. D. Bradford. This may be regarded as a classic example of poor line quality and unnatural slowness, as opposed to good average line quality by a writer who habitually uses a rapid movement in his signature. The good line quality of the genuine signature on the second line is best shown by three strokes which comprise the connections between capital letters and the first up-stroke of the capital "B". A similar good quality is shown in the long down-stroke of the small letter "f". In the tracing the corresponding strokes show poor quality and especially so in the down-stroke of "f", which is the type of stroke that demands considerable speed and fluency but here shows a painful supervision of the slow movement of the pen along each millimetre of its path.

Speed of writing, which is correlated with naturalness of handwriting, is frequently shown by slurring of letter forms. In the genuine signature on the second line this is exemplified by the letters "a" and "d". You will observe that when the writer is ready to form the staff of the "a" he has run past the body of the letter, and when he is ready to form the upper extension of the "d", again he passed far beyond the a-shaped portion of the body. In the forgery, even though a model outline was being followed, there is a kind of improvement of these forms—the staff of "a" is against the body and the loop of "d" is closed against the a-shaped portion. There is only one point where the forger permitted himself an almost normal freedom of movement; that is,

in the upper extension of the final letter "d", but doing this caused a serious difference of proportion which you will see by comparing this part with the standard signature on the second line.

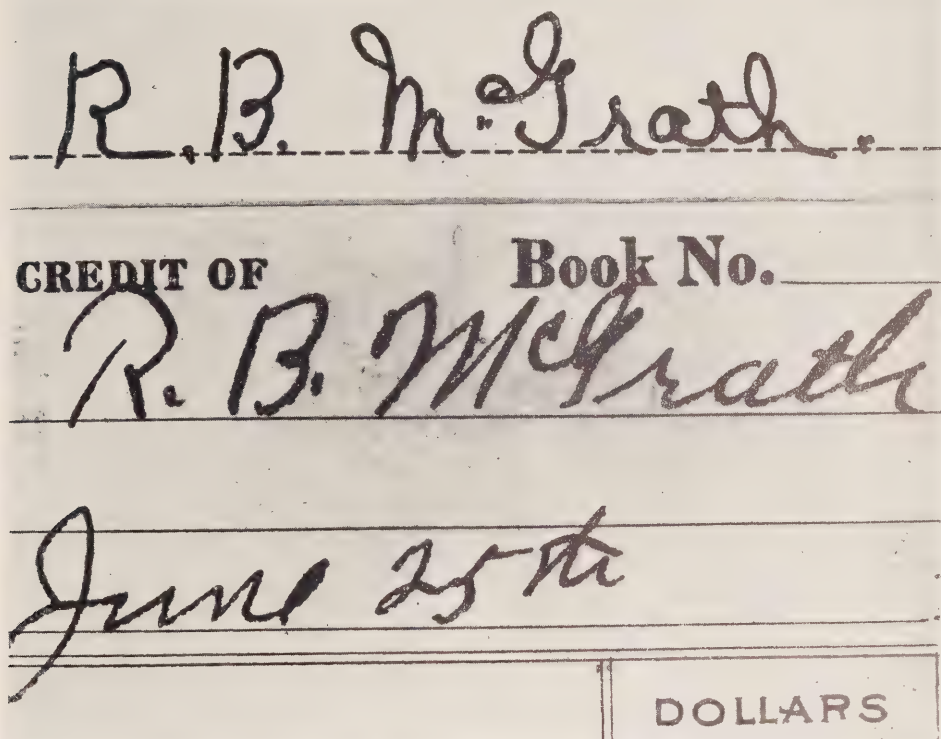


Figure 3

*R. B. McGrath*

The name R. B. McGrath at the top of the next exhibit (Fig. 3) is an example of forgery from a mental image; that is, from a general familiarity with the appearance of the genuine signature (one example of which is shown on the second line) but without actually making a sketch from a model present at the time of producing the simulation. It is well to study this type of forgery in detail because the very points where the forger goes widest of the mark are likely to represent details of his own writing habit. For example, the descending height of the stem and two arches of the capital "M" in the forgery at the top, as opposed to the approximately equal height of the cusps of this letter in the standard signature just below, probably represent the habit of the forger. Again, the curve and recurve in the down-stroke of the small letter "h" in the forgery, so different from the continuous and simple curve of this stroke in the genuine, may well be a part of the habit of the forger. These and other details of the same kind give a good basis for search to find known specimens of the writing of the forger.

*Francis J. McCrone*

Still another type of forgery (Fig. 4) is exemplified by the name "Francis J. McCrone" at the top of this exhibit. In my opinion this is not a tracing as



from a model signature but this is a sketch or drawing made with a fairly continuous movement while paying attention to some genuine signature such as the one on the second line of the exhibit. It may be expected that the forger will observe the more conspicuous features and this is probably the reason he showed a separation between "r" and "a" and between "n" and "c", but while doing this he failed to observe that in the genuine signature there is a decreasing height of small letters with only a slight interruption of this tendency by the letter "c". The forger has too great a regularity in the height of these small letters and too much increase in the height of the "c". The genuine signature on the second line shows a delicate and skillful handling of pressure,

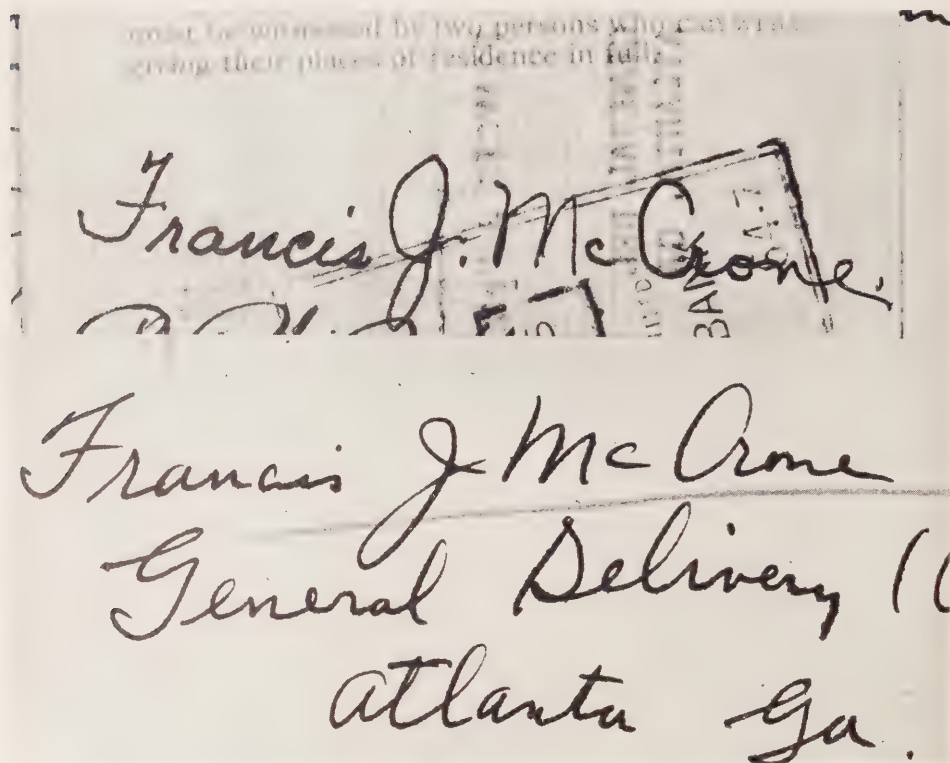


Figure 4

best exemplified by the capital "C" with its almost hairline beginning and gradual increase of pressure all along the left side and then gradual decrease of pressure on the upstroke that forms both the terminal stroke of the "C" and the first stroke of the letter "r". Here pressure is always in a state of change, moving from light to heavy or from heavy to light. By contrast, the plodding, monotonous pressure in the "C" of the questioned signature is one of the clearest indication of forgery.

C. V. Stancill

This next illustration (Fig. 5) shows four standard or known signatures of C. V. Stancill. There is one other signature at the top of this exhibit that is concealed now but will be exposed presently. Signatures should be considered

not just from the point of view whether there is any difference whatever. It could hardly be expected that any two signatures by the same person would be identical. The problem is to form a judgment first about the normal range of

re written.

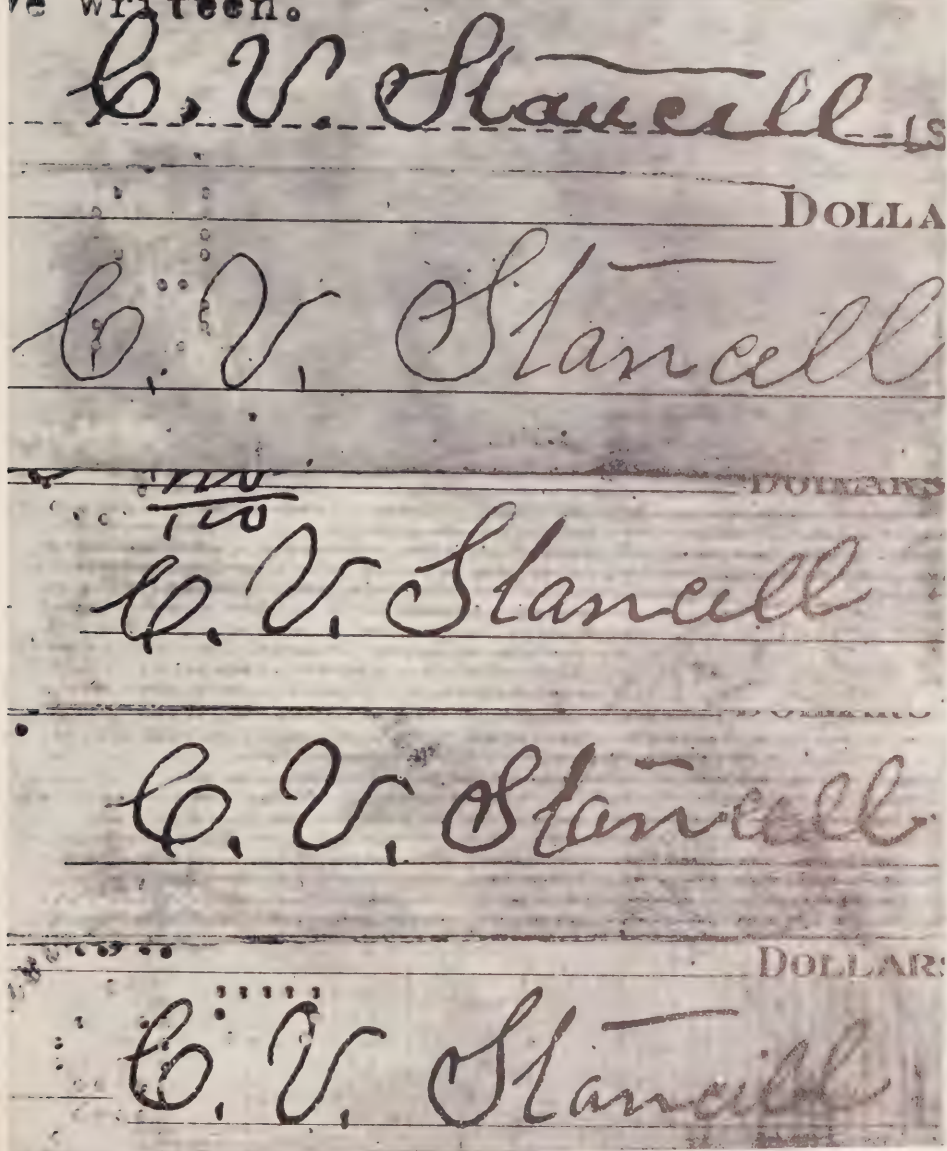
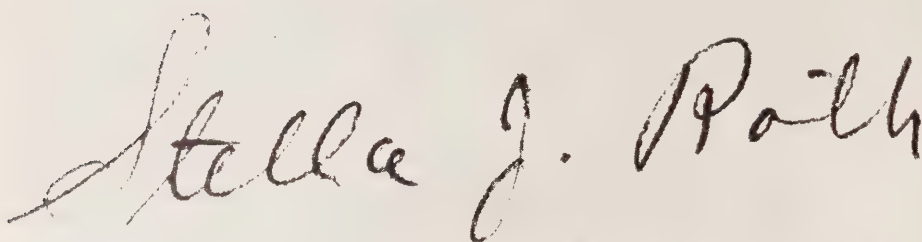


Figure 5

variation in the standard or known signatures and then to consider whether the questioned signature has significant similarity and whether any difference you observe is within the range of normal variation established by the standards or whether the combination of differences is clearly beyond the natural varia-

tions shown by several standard signatures. Now it is true that the four standard signatures, lines 2, 3, 4, and 5 have many superficial variations of the kind that prevent any two from being identical in the sense of having a photographic sameness, but the questioned signature at the top differs in many ways that are not excused by the variations among the standards. The differences in the top signature place it far beyond the permissible variations given by the standards.

Yours truly,



Stella J. Roth

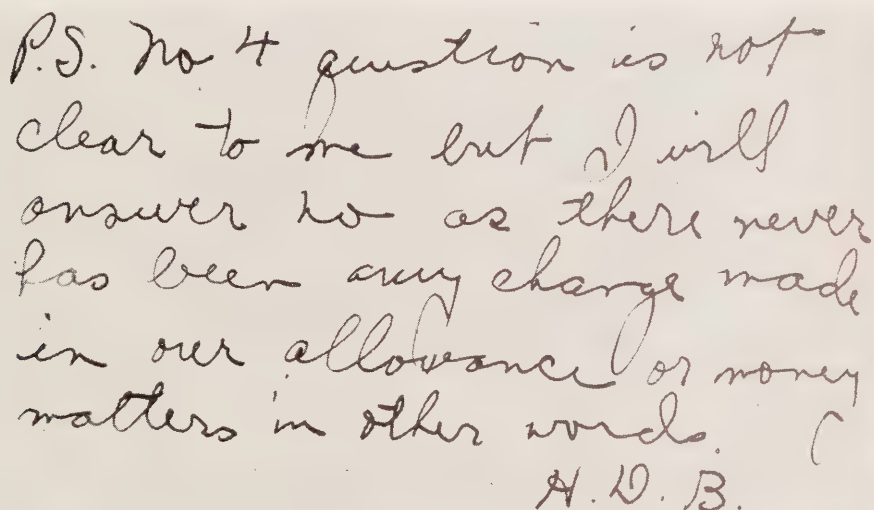
Figure 6

*Stella J. Roth*

In the study of questioned documents one must constantly keep before him the rules and general truths established by examination of a large number of documents—for example, that poor line quality is correlated with forgery, but he must also remember that there are exceptions, or that the apparent operation of one rule may be overcome by the more forceful operation of another rule. This need for caution is illustrated by this signature (Fig. 6) in the name of Stella J. Roth. The first impression is that line quality is poor, and it is also possible to point to specific instances of poor line quality, as in the heavy up-strokes of the “J” with thinner down-strokes, but more important for their opposite effect is a study of the series of upward and downward strokes of the small letters of the last name which show a rhythmical and fluent application of pressure and release of pressure which is one of the most reliable indications of naturalness in handwriting. Further examination will show that a poor writing instrument, an ink that was not compatible either with the instrument or the paper and a paper surface that sometimes rejected ink and sometimes permitted feathering of pen strokes beyond the normal borders of the width of the pen and contribute to an impression of poor line quality, but a general view of the speed, skill, and fluency demonstrated by this signature shows it to be a natural writing. Therefore, it may be said that poor line quality attributable to forgery and poor line quality due to writing instrument, medium, and surface must be understood in order to make a correct judgment. The way to get this understanding is to study forgeries and to study genuine writings made under various impediments.

H. D. B.

No doubt you have heard many persons say, "Handwriting varies so much (my handwriting in particular) I do not see how a consistent pattern can be established by which handwriting can be identified." This comment might be made about this writing signed "H. D. B." (Fig. 7). Consider for example the variety of the letters "t". On the right of the first line in the word "not" we have a "t" with an open tented staff and a cross-bar unbalanced to the right, but the first "t" on the second line, in the word "to" shows a single down-stroke for the staff and the cross-bar unbalanced on the left side, whereas, on the same line, in the word "but" there is a terminal form of "t" with indication for cross-bar made continuously with the staff. Elsewhere in this writing you will find t's with a looped staff—still another variety. The fact is that all of these t's form a part of the writing habit of H. D. B. and the absence of such a variety in any other writing where there was equal opportunity for using them would have to be regarded as significant difference. Of course, this is only one feature of this writing. We have others of very high identifying value. One is the manner of handling pressure. Most terminal strokes end with an increase of pressure, but the really unusual habit is the pulsation of pressure in the longer looped forms such as in the "g" of "change" on the fourth line, and in the "y" of "money" on the right of the next to last line. You will observe that in these lower extensions there is first an application of pressure but before the pen reaches the bottom of the loop this pressure gradually diminishes and is applied again on the rising stroke. This is another of the many identifying features of this handwriting. Others are related to movement, proportion, and unusual distortions of the forms of letters, so that we see in a variable writing it is still possible to establish a pattern of writing habit useful for identification.



P.S. No 4 question is not  
clear to me but I will  
answer no as there never  
has been any change made  
in our allowance or money  
matters in other words. (

A. D. B.

Figure 7

W. J. Moorhead

A useful safety check in the formation of judgments about the identification of handwriting is the rule that unexplained differences either stand as obstacles to a final judgment, or must be given an appropriate weight in forcing a qualification in an opinion. This proposition is demonstrated by the endorsement in



the name of W. J. Moorhead on the last line of the next exhibit (Fig. 8). Other writing on the exhibit is standard or known writing. This and other standard writing all showed that Mr. Moorhead has the very consistent habit of holding the pen pointing away from the right shoulder so that shading tends to appear at the top and bottom of circular formations, such as o, a, and d. Although the endorsement on the last line has a close agreement in the details of letter forms and although the delicate pressure in the stem and center element of the "W" and in the entire letter "M" indicate genuineness, one must take note that in this endorsement the pen was held pointing to the right shoulder—not outward from the body as in the standards. This different position of the pen causes the wider parts of pen strokes to appear fairly high or along the sides of circular forms, best noted in "a" and "d". There is a strong suggestion of a natural

now we will certainly  
be yours sincerely  
W. J. Moorhead  
Sparta, Oregon.

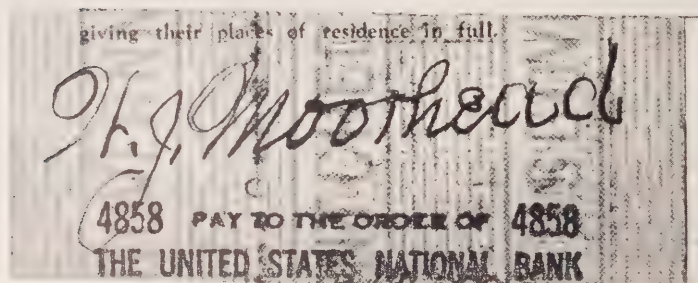


Figure 8

awkwardness in the entire name but the single observation of a radical difference regarding pen position was regarded as reason for a qualification in the judgment that this is a genuine endorsement. The person who accepted this check for encashment (not knowing that any detail of the endorsement needed an explanation other than the circumstances that the payee denied writing it) said to the investigator, "The name W. J. Moorhead was written on the check here at this low table. The writer did not try to place his legs under the table nor place his arms on the table in a normal manner. Instead, he sat here with his legs thrust straight out and he leaned forward with arms extended and wrote the name you see on the back of the check." Now this explanation of the conditions under which the endorsement was made fitted so well the actual effect

## CROSSNORE SCHOOL, INCORPORATED

CROSSNORE, NORTH CAROLINA

Be the undersigned officers of Crossnore School, Inc., hereby agree that the salary of C. McCoy Franklin for services rendered to Crossnore School, Inc. and payable to him by said school, shall be \$100.00 one hundred per month payable at the end of each month. It is further agreed that all of said salary not paid to him by check and recorded on the books of Crossnore School Inc., shall be considered loaned to said School at the end of each month and shall begin bearing interest at the rate of 4% per annum from that date, interest to be compounded annually and added to the principal. It is agreed that no statute of limitations or any other debts, laws or limitations shall waive a full and prompt payment of all money thus left to accumulate when payment is demanded by C. McCoy Franklin, his heirs or assigns. All lands, properties, endowments and assets of said school, owned now or acquired hereafter, shall be surety for the above loan until same is paid in full. The above arrangement shall continue during the term of C. McCoy Franklin's connection with Crossnore School Inc., unless terminated by said C. McCoy Franklin and so stated in writing. It shall be left entirely to the discretion of C. McCoy Franklin and as to when the above moneys shall be collected by him.

This Contract made and entered into on this 15th day of September, 1921.

*Mary M. Sloop*

*C. McCoy Franklin*

*M. S. Wise*

*B. D. Franklin*





Figure 10

in the handwriting as to remove the weight formerly given to the difference. In a writing position such as that described it would not be easy to turn the hand so as to point the pen away from the body. Instead the pen holder would be drawn toward the body and shading would tend to fall on the sides of circular forms.

### *Crossnore School*

Here is a document (Fig. 9) which, if genuine, would be worth a very large sum of money. In fact a lower court in the state of North Carolina once granted a judgment against Crossnore School for a very substantial sum. Not until that action did the document come in for a critical examination. The signatures are genuine but let's consider some other features. Here is a photograph of the same document (Fig. 10) made with all illumination passing through the paper and with a blue filter over the lens to absorb the blue typewriting. High contrast film was used and the print you see here was made on high contrast paper. The purpose was to secure a record of the light transmitting properties of the paper of the questioned document. Now you see in the approximate center there is a neat window, indicating a seriously thinned area of the paper. But there is an interesting pattern in this window, a kind of intermittent effect as from lines that are seriously thinned and other lines that are less seriously thinned. The erasure of typewriting, requiring heavy erasure along the line of type and less erasure between lines will produce such a pattern. At the upper right of the window you see a single line of thinning that corresponds to the position of a typewritten date line. With these observations in mind look again at the face of the document. If you should make the appropriate measurements you would find that the body of the contract was written by a machine spacing 12 characters to the inch, whereas the ruled lines for the signatures were made on a machine spacing 10 to the inch. Now we have evidence that there was in existence a document bearing about six short lines of typewriting and on this same document there were ruled lines for signatures. The whole of this short document was prepared on a machine spacing 10 to the inch. Later the few lines of writing in the body of this document were erased and the signatures were allowed to remain and then a new 16 line contract was written with longer lines of typing. Another interesting point you may want to consider is whether the paper carrying the printing at the top "Crossnore School . . . ." was actually a continuous whole with the lower part of the document. It is now separated as by repeated folding but I believe it was never a whole with the lower part of the document. This case teaches the important lesson that we should always look through a document, which you might add to the equally important advice of always look at the back of a document.

*\$750 or \$42.90?*

A document is usually thought of as a two dimensional object but the document analyst knows that the depths of the paper frequently yield important evidence. It is also true, however, that if you consider only the surface there is still an effect of varying depth in a document. For example the lithographed design of a safety tinted paper should stay in the background, should seem further away than the strong letterpress printing of the check form. There is some danger of seeing only the more boldly printed matter and of not penetrating to the depths of the surface, if that expression may be used, where other faintly recorded matter may be present. Here (Fig. 11) there is shown the amount of a check reading "750 Dollars \$750" in very bold printing. A bank teller paid the amount on this check, no doubt because his eye stopped on the level of this bold printing. On a somewhat lower level there is evidence that the original amount of this check was \$42.90. This much smaller amount was lightly printed on the check as originally drawn and the forger further reduced



PAY 750 DOLLARS

OF -

Mrs Julia Dingos  
17 Railroad Ave  
Nazareth Pa  
33 485 260 Dingos

Victor Anthony

JUL-11

\$750

Figure 11

it but did not erase it completely. Here again we get some useful advice: Try to see the depths of a document, not just the surface represented by the more boldly printed matter.

Wm. F. Resch

A document may sometimes be tested from the point of view of what is said about the conditions under which it was produced when not much progress could be made if nothing at all was said about the document. Here (Fig. 12) you see two standard signatures of William F. Resch and below them you see

**STANDARD**

William F. Resch

Wm F Resch

**ADMITTED**

negotiated.

nie chec

Wm F Resch

**DENIED**

negotiated.

Wm F Resch

negotiated.

ested

Wm F Resch

Figure 12

one admitted example of his signature. It is admitted but not standard in the sense of representing his normal writing habit. It was admittedly made by Mr. Resch under circumstances that interfered with exercise of usual writing skill. The story that accompanied these signatures is this: The admitted signature is the endorsement on a check. At the time it was made this person said that he had with him two other checks. These two other checks were later cashed without his knowledge and the endorsements on them are shown under the heading "Denied". Will the denied signatures give information that corroborates the story? Look first at the circular form at the beginning of the capital "W" of the admitted signature. You observe a wide gap or hiatus. The point where this gap begins shows a tapered stroke, indicating that the pen was in motion when lifted. The area where the pen is returned to the paper also shows a tapering-in of pressure, and the aspects of the ends of these strokes shows that there was a full circular movement even though pressure was so light that the movement was not fully recorded. Again, in the admitted signature there is a similar record at the base of the capital "R". There is a strong indication here of a continuous movement, even though pressure was reduced to zero along the left side of the base. Now passing to the two denied signatures you observe blunt endings for the most part on either side of the hiatus at the beginning of the "W" and the aspect of the strokes indicates non-continuous movement. These and other details of the same kind show that the two denied signatures are simulations—not of the ordinary standard signatures of William F. Resch, but simulations of the admitted signature shown here. Whereas the hiatus at the beginning of the "W" and the one at the left of the base of the "R" of the admitted signature were accidental—the result of writing rapidly and with more than usual carelessness—the gaps in the denied signatures were made deliberately upon the erroneous assumption that they represent habit.

### *Mindszenty*

A dramatic emphasis of the proposition that a document may be tested in the light of what is said about it is given by this page from a New York newspaper (Fig. 13) showing a part of one of a series of articles entitled "The Mindszenty Forgeries". In these articles it is stated that the police asked for validation of the document shown here as Exhibit E. This validation was refused with the statement that the document was a poor forgery which would fool no one even though a validation should be given. It was volunteered that a better forgery could be made. Upon hearing this the police demanded that a better forgery be produced and Exhibit D is said to be the result. Now here is the situation according to this article: Exhibit E is characterized as a bad forgery by an unknown forger. Exhibit D is represented as a better forgery made at the request of the police and the forger is not the same person who made the so-called bad forgery. I was asked to say whether either or both of these documents are forgeries. I replied that it would be impossible to form such a judgment from a newspaper illustration but that it may be worthwhile to study them from the point of view of their consistency with what is said about them. Now I formed the opinion that these two documents, Exhibits E and D as shown in the newspaper were not in the same scale. We do not know the original size but if one of them should be assigned the value of unity and if any similar word should be found in the two documents and then both photographed and adjusted to the same scale upon the basis of this similar word there would then be an opportunity for further comparison by means of these photographs. Upon doing this it was found that seven lines of the so-called bad forgery, Exhibit E, are identical to a certain seven lines of the so-called better forgery! This would be impossible—that





Список книг

1 JNB

stat

и вышло 100,000 шт.

полаг, выходящая книга,

написана, покаяние

вышло после смерти

книжки покаяния выходящая,

и выходящая книга

и выходящая книга

EXHIBIT D

Figure 14

before they appeared in this newspaper article. This case illustrates not only that a document may be tested in relation to what is said about its history or means of production, but it also shows that a document may be tested in relation to an appropriate question. The question "Are they forgeries?" cannot be answered from the newspaper illustrations, but when this question is scaled down to "Are the documents consistent with the statements made about them?" we can get a useful answer. The Examiner of Questioned Documents is not concerned only with the questions that others ask about documents but he must sometimes suggest how these questions may be modified so as to serve as a reasonable basis for investigation.

The really wonderful thing about the study of questioned documents is that every document has a lesson to teach. While much of the work with them is burdensome, this work can be lightened by a demand that each document give up its lesson to you for application to the next problem.

Thank you for your attention. It has been a pleasure to meet with you. I am certain that our common interest in these problems will make it possible for us to answer more questions with more certainty, but always in a sober and conservative manner.

### Discussion of Mr. Cole's paper

GODOWN: I might comment regarding the projector you are using, they have a portable model of this too, which folds up considerably more, but they are bulky even though not too heavy. The same company which is the Vestler Enlarger outfit, also have transparency materials in various colours to make these large size transparencies, which develop dry by ammonia processes and diazo processes. They have a number of things that go with this type of illustration material that have a lot of good features and has some interesting possibilities, particularly for office work.

# Counterfeit Stamps and Stamp Impressions

(Original in the French language)

JEAN GAYET

Scientific Police Laboratory

Lyons, France.

Nowadays, it is a custom in the administration to affix an official stamp impression to a document or a signature for the purpose of giving a character of authenticity or genuineness. Two types of impression are in common use: damp impression involving stamp pad ink or printing ink and embossed impression.

When the counterfeiter fabricates fraudulent documents or alters genuine documents, he strives to obtain impressions which will be as similar as possible to the genuine ones. So we will examine impressions on documents completely fabricated and also impressions on altered documents, e.g., affidavits, identification cards, passports, car owner certificate (*carte grise*). We even found fraudulent impressions on fraudulent paintings, pretended to be the work of well known painters. Let us mention that the presence of such impressions on paintings would ordinarily indicate that these paintings were exposed at artistic displays and consequently have been recognized as genuine ones by the critics.

The duplicating of a fraudulent impression varies essentially according to the type of stamps used. It varies also according to whether the counterfeiter fabricates an entire impression, or completes an already existing impression. Let's give an example for each case:

*Entirely fraudulent impressions:* fabrication of a "*carte grise*" which is a certificate of ownership of a car in France. The counterfeiter gets paper similar to the one used for genuine cards of that type, prints same text, fills in names and other mentions to suit his needs, and affix the impression of the department issuing such documents.

*Altered impressions:* the counterfeiter would get for example an identification card in this usual way, he would steal it. His first operation would be the replacement of the photograph on the stolen card by his own. He would then change or modify the text to his choice. And finally the original impression being always partly on the document and partly on the photograph, that part of the impression removed by substituting the photographs, would have to be drawn by the counterfeiter.

Here is the plan to be followed:

1. Damp impressions (stamp pad ink, printing ink).

- (a) entirely fraudulent

- the methods of obtaining them.

- how to recognize them.

- (b) altered

- methods used to make alterations.

- how to recognize them.

2. Dry impressions (embossed writings)

## Damp Impressions

### (1) Entirely fraudulent

#### Methods of obtaining them

- (a) Hand drawn: the most simple method. The counterfeiter draws the impression first in pencil, then he inks slowly over the pencil writing, lifting his pen from the document, once in a while in an effort to make the impression as natural as possible (to produce accidental characteristics). (Fig. 1). In most cases the drawing is extremely rough and a simple examination with a magnifying glass would permit the examiner to recognize the imperfections and the double pen strokes necessary to duplicate the thick lines. (Fig. 2)

In the case of duplicating a rectangular impression, the defects could be quite apparent in the pen strokes due to the lack of attention or experience in drawing the frame (Fig. 3). If the impression is circular, the use of a compass is suspected and usually leaves a small hole in the paper made by the metallic end of such an instrument. Sometimes, in an effort to hide the hole, a small ink stain is placed on it. Examination with magnifying glass or transparency reveals the fraud. (Fig. 4) (Fig. 5)

- (b) Hand drawn after tracing with carbon paper: wishing to do a good drawing the counterfeiter would trace using carbon paper a genuine impression, then ink the carbon traces. Examination under magnifying glass would detect carbon residue, because the two lines never match exactly.
- (c) Obtaining impression from partly altered stamp: here the counterfeiter would use any stamp at his disposal and complete the impression given from it by a hand drawing. We have two examples:

*Circular impressions:* a stamp of the desired size would be chosen, the centre portion blacked with paper, and after inking (stamp pad ink or printing ink) such a stamp would make the impression on his document. He then completes the centre portion of the impression with a drawing (pen and ink), but the fraudulent impression would be recognized from a difference in the colour of the inks—also the drawing in such cases is very rugged and could appear genuine with a rapid and casual examination without a magnifying glass. (Fig. 6)

*Dated impressions:* the impressions used on passports bear the name of the frontier, the mentions "in" and "out" with the date of passage. The counterfeiter would get hold of a dating stamp similar to some extent to the one to be imitated, stamp the document with the proper date and complete the impression by drawing (Fig. 7). But in his drawing the counterfeiter cannot match the colour of the original ink and even if he did, a lack of homogeneity would usually result. In such counterfeittings a lack of homogeneity would always be noticeable either in the variation of the colour of the inks or in the irregularities of the density of the ink strokes.

- (d) Counterfeiting from individual rubber characters: if the document to be duplicated is composed of a text of any length at all, the counterfeiter would use the well known rubber characters used in commercial printing. On the Italian passport is found one large impression occupying the whole document. The text would be as follows: "This present passport is valid until (date) for the following countries (list of countries). Established at (name of the city), the general consular



(place of the signature). The stamp producing this impression was made up to facilitate the completion of such documents. The passport bears also the signature of the authority issuing the passport and an official impression of the Consulate or the Legation. Using those individual rubber characters the counterfeiter would compose the required text and stamp the blank document.

Usually he cannot print the whole in one operation and he has to do it in two or three similar operations and so keep the lines parallel which adds to his difficulties. Should the text to be duplicated be very extensive the counterfeiter might get short of those characters so he would draw some of the letters or replace a character which he has run out of, by a similar one: e.g. "O" for "0" (Fig. 8). Some documents require new impressions at different time intervals. The counterfeiter would make a new stamp every time a new impression is required, destroying the previous ones. The reason: it would be incriminating if the counterfeit stamp was found in his possession. The method of examining two such impressions is by superimposition of two photographs, one a positive, the other a negative. (Fig. 9).

- (e) Duplicating an impression with the aid of a fabricated stamp: Counterfeiters have found a way of duplicating an impression from their own fabricated stamp. On tracing paper he gets the impression from the document (Fig. 10), then this impression is traced on vulcanized rubber plate or a plate of plastic material. Then using a razor blade and small engraving tools he cuts around the letter. A handle is glued to this plate and the fraudulent stamp is made. With the same process he can also make the frame and fill the interior with the desired text. The fraudulent impressions made by such a stamp is recognized by the irregularities in the form of the letters (Fig. 11).
- (f) Modification of a discarded stamp: finally the counterfeiter could have recovered a discarded stamp or stolen a bad stamp which was put aside for destruction. Here again, using a razor blade he cuts off a certain portion and replaces it by another one. To effectuate this replacement, a negative plaster casting then a positive gelatin casting is made. The plate thus obtained is glued in the hole left on the stamp. This method is dangerous because when examiners are confronted with an impression involving a very difficult to duplicate portion and that portion has been left intact, the examiner might be inclined to say: nobody could have done such a good job so it must be a genuine impression. While what he has on hand is a modified impression where the most difficult to produce portion is not the one that was modified (the engraving of the "republique francaise").

Such modification can be recognized because the new line will be off balance, and the new text usually differs in thickness from the rest of the text and so when stamping the impression a difference in the intensity of the ink will be apparent.

#### *How to recognize a fraudulent impression*

Examination of text of impression—Read every word carefully, look for spelling mistakes, type faces replaced by others having a similar form or type faces placed upside down, e.g. "E", "I".

Examination of paper by transparency—If transparency is not uniform, throughout the document chances are mechanical erasure has been attempted. If the impression is circular, a small hole in the centre would correspond to the end of the metallic point of a compass, used to draw the circle.

Examine colour and ink of the stamp—If the impressions appear in two different colours, or irregularities in the ink are noted, a partly drawn impression can be suspected, or also an impression obtained from an outdated stamp with a portion changed (the portion added to the outdated stamp was not glued at the same height as the remainder of the type characters and so did not print with same intensity).

Examination of the strokes with a magnifying glass—First examine the angles of the frame ( $90^\circ$  angles), if the ink strokes go over the frame, this could indicate a drawn impression and the counterfeiter has probably drawn the frame without the use of the necessary instruments.

Examination of the wider strokes—Hesitations and resumption of some strokes, two or more strokes partly superimposed to form a wider stroke. If present, then there is no doubt, the impression has been drawn. If here and there appear portions of strokes of different colour or portions of strokes covered by the impression, then an impression drawn after tracing can be suspected. Irregularities in the form of the characters should arouse suspicion towards a hand-drawn impression or even an impression obtained from a rubber stamp made by the counterfeiter himself.

The examinations just mentioned could all easily be made by the investigator, who could afterwards get results confirmed by a laboratory. The laboratory expert would do more extensive examination.

#### *Laboratory examinations*

The impressions are examined under the ultraviolet light. This would place in evidence any area on which a liquid eradicator has been used or a mechanical erasure has been attempted.

Analysis of the inks to verify whether a writing ink, (fountain pen ink), printing ink or stamp pad ink was used.

Comparison of the suspected impressions with the genuine impressions. Photographic enlargements might permit to establish some differences between them.

## **(2) Partly fraudulent stamp**

Let us start with an example; an identification card from which the text has been erased, the original photograph removed and replaced by the counterfeiter's own photograph. This substitution leaves the counterfeiter to complete on his own photograph, that part of the impression that was removed (known) with the original photograph. The only method at his disposition is drawing. If the impression is circular he has to rebuild the circle and generally, on the paper small holes will be found, corresponding to the effort of the counterfeiter to locate the centre of the circle. Evident also will be the hesitations of some of the inks strokes and the slipping of the pen on the edges of the photograph with the magnifying glass. And finally, most likely, a difference in colour will be perceptible between the ink of the drawn portion (Fig. 12). In this example, the fraudulent part is in the portion that has been added to the document. We had cases where this was reversed.

In certain countries, a "fiscal stamp" is placed on the passport and this "fiscal stamp" is obliterated with a stamped impression of the consulate or the legation. On this type of passport, a new "fiscal stamp" is added every-time a prorogation of validity is requested. The counterfeiter who utters a passport for his own use is obliged to put a new fiscal stamp for each prorogation of time. To do that he gets "fiscal stamps" from discarded and used passports, glues them on his own passport and completes the impression by

drawing. Figure 13 demonstrates two examples of this type. It is noticed that the counterfeiter, each time had difficulty to determine the centre of the circle to draw.

The investigator will sometimes meet a case where the "fiscal stamp" is obliterated the way it should be, but in addition the document bears a complete impression, a portion of which is covered by the "fiscal stamp".

We had one or two cases like that and here is the way it is done:— Dishonest civil servants employed by the passport department would collect "fiscal stamps" from discarded passports and use them over again. Those civil servants had at their disposition the stamp which had served to obliterate those "fiscal stamps". So, they just stamped the passports, glued the used "fiscal stamps" in such position that the impressions correspond exactly. Such a fraud can go a long time unnoticed but becomes apparent as soon as the "fiscal stamp" is removed.

### **Embossed Impressions**

We do not encounter them very often, but everytime, they appear in the same way: the counterfeiter fabricates an identification card from a genuine one. The first operation is to substitute part of the original photograph for his own. But the embossing present on the original photograph must be duplicated on his own photograph. Here are the methods used:

#### ***I—The moulding of the portion of his photograph which will cover the original embossing***

The counterfeiter removes the original photograph except the portion which bears the embossing. Then he takes his own photograph, dips it in water for a little while and with great care the paper on the back of the photograph comes off, and what is left is: the emulsion on a very thin layer of paper. In other words he reduces the thickness of the photograph. At this stage the photograph is very flexible or malleable, it is then glued in the desired position. The embossed portion of the original photograph is transferred on the new photograph. An expert knowing this fraudulent method would detect it easily: the portion of the original photograph shows through the very thin photograph covering it. Also, examining (Fig. 14) the document by transparency, that same portion is noticeable as a dark spot.

#### ***II—Drawing of the embossed portion by pressure with a blunt instrument***

In this instance the original photograph is removed. The embossed impression is hand-drawn on the back of his photograph. Then with a blunt instrument the lines of the drawing are pushed in to give it the appearance of an embossed impression and the photograph is glued on the document. Again this fraud could be recognized by lifting the photograph so that the pencil drawing would be apparent. (Fig. 15).

One variation of this procedure would be the tracing with carbon paper of the embossed impression from the removed photograph and embossing the tracing with the use of a blunt instrument on the new photograph. This can be done also without the carbon paper but it would necessitate more pressure on the tracing instrument (blunt instrument). This is the most difficult type to detect because even when the expert removes the photograph he will find no pencil drawing or carbon deposits on the back of the photograph. But by a very careful examination of the hollows of the embossing he would detect defects; usually hesitations and retouchings. Also certain letters, the "E"

for example. In tracing the embossed impression with a blunt instrument it is almost impossible to keep a uniform pressure all the way; for example the vertical strokes are more or less deeper than the horizontal strokes. This would not be in a genuine impression. Fig. 16 shows particularly the hesitations in tracing the capital "S" and the differences in the degree of embossing in the capital letter "E" in the centre of the impression.

### **III—Moulding from tin paper then reinforced with plaster**

There exists another method of duplicating an embossed impression. In this method, a sheet of tin paper is placed against the genuine embossed impression and with slight pressure, working with the fingers he gets a casting which is reinforced with plaster. He embosses his photograph, previously humidified, with this fabricated stamp. The final operation is to substitute photographs.

#### *Detection of fraudulent embossed impressions*

##### **1. No alteration of the document:**

- (a) Examination of the edges of the photograph to detect suspicious defects.
- (b) Verification of the agreement of the texts: this is done by examining one portion of an embossed letter, e.g. let us look at the top portion of a capital A, in the text of the embossed impression. If a needle is placed from one side, at the top of the letter A, the tip of that needle should correspond on the other side of the impression to exactly the same spot. If this is not the case, the impression is a fraud.
- (c) Examinations by transparency: this shows fragments of the first photograph and also permits to detect traces of a pencil or a carbon paper drawing.

##### **2. With alteration of the document:**

- (a) The photograph is removed and examination of the back to detect any pencil or carbon traces. The hollows of the embossed impressions are examined for hesitation in the strokes and the differences of the degree of embossing of each stroke or line.
- (b) Comparison of the pretended fraudulent embossed impressions with embossed impressions produced with the genuine stamp.

(During his visit to Canada to attend this Seminar Mr. Gayet was asked numerous questions relating to the position of the handwriting expert in France. In an effort to answer these questions, Mr. Gayet prepared a short paper which is here translated).

### **The Handwriting Expert in France**

1. There exists in France a certified list of handwriting experts which is established by the President of the Civil Tribunal in conjunction with the Attorney-General. In order to have his name placed on this list, a candidate must submit a request to these parties; stating in his submission what knowledge he possesses in the particular field so that his competence may be determined. In considering the request, the President of the Civil Tribunal and the Attorney-General also take into account the reputability of the candidate, and may either accept or refuse his request.

2. In both civil and criminal matters, and also in private cases, only the experts from the above mentioned certified list can be called, but there are exceptions.

3. Persons qualifying as handwriting experts fall into three different categories:

Archivists paleographers: they necessarily possess some knowledge of penmanship.





Fig. 1

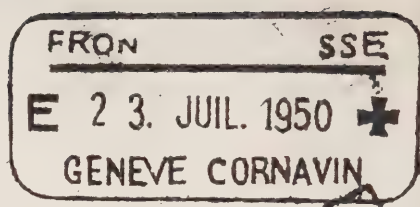


Fig. 2

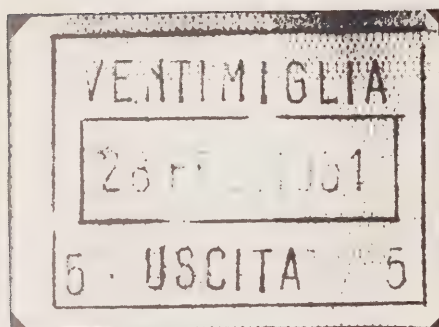


Fig. 3



Fig. 4



Fig. 5



Fig. 6

QUESTURA DI LUNEO  
 Pecunia Carlo  
 3336150

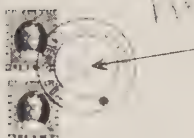


Fig. 8

CONSOLATO GENERALE ITALIANO  
 MANIFI  
 7-10-06 PERIOD. no 3304  
 EST. 1951  
 L. 10, 50  
 2365  
 14 JUN 1951  
 ROMA ROMA ROMA ROMA  
 ROMA ROMA ROMA ROMA  
 ROMA ROMA ROMA ROMA  
 15 JUN 1951  
 CONSOLATO GENERALE

Fig. 9

SUR  
 RG POSTE DE PONT S. DUIS  
 20 MAI 1951  
 ENTREE

Fig. 7



les faux cachets  
 utilisés par le

Fig. 11

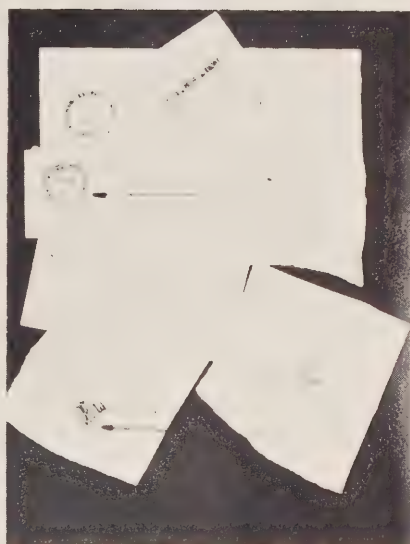


Fig. 10

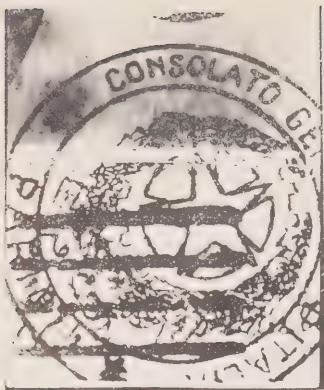


Fig. 12



Fig. 13



Fig. 14

CAMPONS - Paris

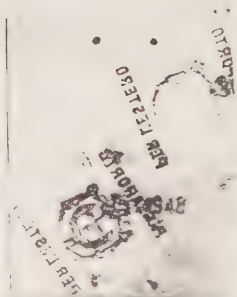


Fig. 15



Fig. 16

Graphologists: they study numerous handwritings in an effort to determine the personality or character of individuals. Their claims as handwriting experts are justified by the fact that they have examined a great variety of handwritings and are able to evaluate such characteristics as pressure, form and movement.

Archivists paleographers, one could say, see handwriting in its static state while graphologists see handwriting in its dynamic state.

The third category of handwriting experts are the technicians of the police laboratories.

4. At present, there are no courses in France for the teaching or training of handwriting experts. Formerly, there was a special two-year course given at the Sorbonne which was established by persons well known in the field. They soon realized however, that the creation of new handwriting experts was resulting in the enrollment of fewer students, and after a few years this instruction was terminated. The lectures given to the students were never published and the students themselves were forbidden to divulge or publicize their notes.

5. The following are excerpts from the draft of the new French Code of Criminal Procedure.

*Examination by experts* (opinions of experts, expert testimony, valuation, appraisement).

Art. 156: States that examination by experts may take place during any stage of procedure, whether during the preliminary investigation conducted by the examining magistrate, or at the trial.

According to Art. 157 special lists, regional or national, contain the names of experts. However, other experts, not mentioned on those lists, may also be called, either by the examining magistrate or by the presiding judge, on the basis of a decision expressing the reasons.

Art. 158: States that the only purpose of calling an expert is the examination of a question of a technical character (whenever the subject is one upon which competency to form an opinion can only be acquired by a course of special study or experience, Tr.)

Art. 159: When the decision to call experts is taken by the examining magistrate, the accused is entitled to indicate, within three days, another expert who will then be called by the examining magistrate, besides that who has already been designated. The examining magistrate can refuse to appoint an expert whose name is not included in the official lists.

According to Art. 160, experts must be sworn, whereby they promise to fulfil their task, to prepare a report and to give their opinion in accordance with honour and conscience.

Experts included in official lists are free from being sworn again each time they are called during the judicial year. Experts not included in the lists are sworn each time they are designated.

Art. 161: Deals with delays in examination by experts.

Art. 162: If the experts wish to get informed with regard to a question that is outside the scope of their competency or specialty they may be permitted by the examining magistrate to be assisted by persons individually designated, especially qualified in the respective domain. Those additional experts must be sworn and must prepare a report which should be added to the report made by other experts.

Art. 163: Contains the rules relative to the removal and affixing of seals.



Art. 164: To be able to fulfil the task they have been entrusted with, the experts may be entitled to cross-examine the witnesses or the accused (or defendant). As regards the latter, questions must be asked by the examining magistrate.

Art. 165: The parties (the accused or the victim) may ask the examining magistrate or the presiding judge respectively, by whom the expert was designated, that the expert make researches or ask the opinion of any person individually named who could be able to provide him with technical information.

Art. 166: The report must contain a description of what has been done by the expert and his conclusions.

Art. 167: The parties (the accused and the victim) are informed about the conclusions, and they are entitled to formulate their remarks and ask for a supplementary examination by experts or for a counter-examination. The examining magistrate is free to accept or refuse the request, but he must state his reasons in writing.

Art. 168: At the hearing the expert explains his report, after being sworn by the presiding judge. It is admissible, for an expert, to refer to his report.

At the request of the parties or of the public prosecutor or even without such a request the presiding judge is entitled to ask the expert any questions, within the scope of the task with which the latter has been entrusted.

Art. 169: If during the hearing a witness is in open contradiction with the conclusions of the expert, the presiding judge asks the advice of the expert and of the parties; he is free to disregard the contradiction and the advice (and continue the trial), or to order a supplementary investigation or a new examination by experts.

---

Thus; a person whose name is not included in the official list may be designated as expert only exceptionally. As a matter of fact, this can happen only when there is no official expert qualified within the particular domain. The expert may be supplemented by another who is trusted by the accused.

When called by the judicial authorities (the examining magistrate or at the public hearing or trial) the expert has not to justify his special technical capacity, as such a capacity has been recognized once for ever (by his inclusion in the official list, Tr.). He is not obliged to answer questions asked by the defence counsel trying to set a trap or to cause embarrassment or confusion. All he has to do, is to answer questions asked by the presiding judge.

### Discussion of Mr. Gayet's paper

SMITH: Mr. Gayet has been explaining to Ordway Hilton how they qualify in France. I think that would be of interest to us all.

GAYET: First of all a person desiring to become a document examiner has to make a request and then this request is considered in the light of the knowledge that he has in the subject. He has to justify that knowledge. The honorability of the person is considered and if you are lucky and have had a chance of having studied document examination under a well renowned person then the chances are your request will be accepted. That is the only way that you can become a document examiner.

SMITH: Does that mean that he is certified by the Court as an examiner and that this must precede his testifying.

GAYET: That is right, and his name is entered on the certified list that the judge keeps.

SOMERFORD: Do the graphologists appear in Court as expert witnesses? Are they recognized by the courts as such, and permitted to testify to the character of an individual?

GAYET: The graphologists in France exist, but they cannot go to Court on graphology. They can go to court and give evidence on document examination though.

COLE: In making general preparations to deal with counterfeit stamps, to what extent does one make a broad collection of standards for comparison?

GAYET: There are no collections of rubber stamps or rubber stamp impressions. All the examinations are done through the fraudulent impression, that is of the physical features of the impression, but if it is felt that the original is required then they get the original stamp, but there is no collection of such standards. In France, as I have mentioned before there exists a certified list of experts. All the experts are on that list, and this list is established by the President of the Civil Tribunal in conjunction with the Attorney-General. Now in order to be admitted to that list a request must be made to those two authorities. The person must state the knowledge he has in a specialty in order to justify this field and also his integrity will be considered. In civil matters, in criminal matters or private affairs only the expert from that certified list can go to court and give evidence. As far as handwriting experts are concerned, they are chosen from among the paleographers who study ancient writing, from those who know a bit about penmanship from amongst graphologists who study handwriting to determine the personality or character of people and finally the handwriting experts which are the technicians of the police laboratories. Actually, in France there exists no teaching to develop handwriting experts. In the Sorbonne, there was a course of two years' duration which was given about fifteen years ago. It did not take long for those teachers to realize that they were developing too many handwriting experts and by doing so the clientele or the number of persons coming to them would diminish. So it stopped right there. The teachings that those professors gave were never published and the students were not permitted to divulge the notes that were taken during those courses. Now let us take a case in civil matters, for example, the case of a contested will, because they have that case often in France. The person contesting the will, will go to a lawyer, and the lawyer will indicate to that person a document examiner. Then that document examiner will examine the document, will report on the examination of the document but that first report of the document examiner has no legal value at all. He just issues that report to justify or to warrant a further study of the document. Then the judge calls in the two sides, like the defendant and the plaintiff in this case in accordance with the two parties he chooses three experts, or those two parties if they can agree on choosing three experts themselves, they can do it, but usually it is left to the Judge. Then the plaintiff and the defendant get together to decide on what will be the specimen writing to be presented for that particular case and each party shows the other what he intended to present and they discuss the matter there. If one party decides that the other party is submitting a specimen writing which has no value, it is eliminated. But should one refuse to recognize as authentic the writing submitted by the other, then only the writing or the documents done through a notary, or bearing some seal of authority, are the documents accepted. When the two parties have decided which document to present to court then the three experts are asked to come to the court and they make an examination

of the documents that the parties have decided to enter as handwriting specimens. Those three document examiners must be chosen from the certified list that the judge has in his possession. If those three document examiners should arrive at different conclusions, let us say two document examiners would arrive at a positive identification and the other one would not exactly arrive at the extreme opposite, but perhaps feel no opinion can be expressed, then there would be a report issued which would mention everything that the three document examiners have found, the positive identification and also of the other document examiner's conclusion. The three document examiners would sign this report but it is forbidden to mention which one of the document examiners has arrived at the conclusion which is not exactly the same as the other two.

## Panel Discussion "D"

November 1

Members: Messrs. Duke, Somerford, Godown, Duxbury.

Moderator: Mr. Hodgins.

### Topic: Ethics and Evidence

**Question (1): How should Document Examiners contend with the increasing popularity of graphology?**

GODOWN: There is no easy answer to the question that is posed, but I think one thing that we should do is to not shy away from at least a knowledge or a survey of the literature of graphology in order to acquaint ourselves first hand with the type of people who are publishing material of that type, their inconsistencies, their good points, and to form some personal evaluation of the people who are active in the field and the possible value of graphology. If you know something about something you can speak about it, otherwise you cannot. The other thing that I think we should keep in mind, whatever our ideas with regard to graphology, is that in making any statement in public about it it would be unwise to indicate a prejudice, particularly if you are asked a question in court with a jury, because you may well have people on the jury who either themselves believe in it or have some person that they respect greatly who has a belief in it. You may even find judges and lawyers sympathetic to it, so that what you say should be carefully considered in advance. Those two things we should do, familiarize ourselves with the literature of the field and be prepared to intelligently and unprejudicially, answer questions without evoking antagonism.

DUKE: I do not think graphology in itself presents any great problem to document examination. Probably a greater problem, since we are dealing with ethics in evidence, is those members of our own profession who are not so inclined as to keep their practices of the highest professional standard possible, who are more inclined to give an opinion for what it may be worth financially. I do not think there is any great difficulty with graphology and the forensic identification of handwriting since the two fields are, I feel, quite a way apart.

**Question (2): Should the presentation of qualified opinions in Courts be encouraged?**

SOMERFORD: Certain types of examinations require a restriction in the conclusion that is arrived at. As long as the examiner is required by a subpoena or other means to present testimony relative to any laboratory report it is in the interest of whoever he is working for to present the evidence developed by the examination, regardless of the extent of the findings. I think that is his duty as it is his duty to present the facts about a definite conclusion because it might help the case to be settled more properly. We have given qualified opinions which when given with other supporting evidence was rather conclusive that the defendant was guilty of a particular offence.

DUXBURY: I gather that the question means, encourage the Prosecuting Council or the investigator to use that evidence. I do not know how far we



should go, but I think they should be made aware of the value of the evidence. The tendency in the mind of a lot of investigators and in the minds of some courts is to want the expert to make their case rather than consider the case as a number of independent circumstances which build up one upon the other.

HODGINS: The suggestion has been made quite frequently that we either have a completely positive opinion on the matter or no opinion at all. Would you say that it naturally arises that if we have an opinion falling in between the two that we should within our power refuse to give such an opinion?

SOMERFORD: Definitely not. We have been able to settle many cases with the rendition of a qualified opinion as long as the qualifications are clearly stated. The clue that was given in the idea that the individual was probably or likely the person responsible would enable the investigator to pursue that individual in his investigation and very often it resolved itself into a solution.

DUXBURY: In some cases a qualified opinion may have a greater real effect on the court than a positive opinion and that is when it is given with reasons for the qualification. They take it as sound.

DUXBURY: In the case of Bishop Lincoln versus Wakeford wherein a qualified opinion was given because of the limited amount of writings the court in this case, the Privy Council (1921), in summing up, stated that this is the way such evidence should be given. In another case also in the province of Alberta where a qualified opinion was given, the court took the attitude that if the examiner cannot be certain, how can the court make up its mind.

SOMERFORD: In some cases that it adds to the testimony in showing that the witness is trying to be fair.

GODOWN: You have to think along the line that a qualified report is one thing and qualified testimony in court is quite a different thing and they might serve different purposes. Under our legal systems, there are two kinds of witnesses. There is a witness who is testifying as to what he sees or hears and then as an aid to the court there is what is called "opinion evidence" given by a man who is a specialist in a particular subject. He is the only witness that can state an opinion to the court. Now some people in the field of jurisprudence would say if you reach a point of qualification where you do not own an opinion, and since you are not in court as a witness to a fact you should not be giving evidence.

DUKE: The expression "a qualified opinion" does not mean that the examiner is not sure of his opinion. It means that he is definitely of the opinion that, for instance, there is a probability that the two have common authorship. It is a definite opinion, that there is a certain degree of probability that an event has occurred.

GODOWN: There is the idea that with respect to some aspects of the testimony you are not an opinion witness but you are pointing out similarities and differences, this fact as opposed to this fact, to enable the judge or the jury to make their own comparison. Now are you a fact witness or an opinion witness under such circumstances?

HODGINS: Are you suggesting then that under such circumstances we should merely point out the facts as we see them and leave the court to draw conclusions?

GODOWN: I can conceive of circumstances where that would be what you would be permitted to do and if you held no opinion you should not get into the realm of probability.

HODGINS: In merely pointing out differences or similarities as we see them and admitting that we are not able to arrive at an opinion but leaving it to a lay jury let us say to decide the facts are we not tending to admit our own inadequacies and toss our problems to less qualified persons?

SOMERFORD: The court should and the jury are allowed to take advantage of every item of evidence that would help them to make a decision regarding the problem that is before them, be it in the form of the expert testimony or be it in the form of an investigator or any other type of witness. It may be that there are certain aspects of a presentation made by a document examiner which will clarify the issue. We must remember the handwriting examiner does not go into any court with the idea of that he must be believed but merely goes there to aid the court and the jury and in that capacity he gives a statement as to what he has observed leaving it up to the court and jury to decide.

**Question (3): Is the use of technical reports without the personal attendance of the examiner feasible or desirable?**

DUKE: The use of these reports without the personal attendance of the examiner is feasible that is I think it is possible but I do not think it is desirable as it has the tendency to place all experts whether well qualified or not on the same level. It would be difficult to distinguish between a competent expert and one who is incompetent.

SOMERFORD: I can only speak in terms of my own experience, but we do not advocate going into court, before Commissioners or before grand juries unless it is for the purpose of enabling a new examiner to develop a little training in testifying. As a general rule we suggest that the report of the laboratory would be sufficient to satisfy those two types of presentation. As to the presentation before the courts, military courts and so on we certainly do emphasize the importance of the examiner being there, if for nothing else just to give the opposing council an opportunity to question the individual as to the basis of his findings.

GODOWN: I approach this from a somewhat different viewpoint than those who are in public service. First let me comment with respect to what Mr. Somerford has just said. A report is not evidence in a court. There is no evidence in a court unless there is an opportunity for cross examination in some way, shape or form. You have to have testimony, an affidavit or a report is not testimony. In civil practice where we have a different situation, economically, than you would have in public service with respect to some things, the question is whether there is a method by which testimony could be introduced in small matters that do not justify the travel or the cost that would be involved in personal attendance. I believe that there is a field for it in both public service and in civil work. I think that we would greatly extend our sphere. We have a professional obligation to seek better ways to serve the public, publicly or privately and to make our services available. However, I worked up a paper on this one time and was very much surprised to find that in some quarters they think that it is controversial to suggest such things. Whether it should be extended to all classes of technical evidence in small matters, how far it could be taken, would have to be considered very carefully. Many people in a typewriting factory who have the fundamental information that is needed in a typewriting case have never been in court, their employers are not willing to let them go to court. Even if you intimate that there is no possibility of going to court with the information that you seek from them you get no information. Possibly we need a method to employ

their reports in a limited sphere without requiring attendance in court. Just what could be worked out I do not know, but I think it needs the attention of some good legal minds that are familiar with these technical situations.

DUXBURY: What type of report is this going to be if the report was to be accepted in court? Should we give them a very brief report with nothing more than the conclusion reached or should we prepare a lengthy detailed report with photographic charts and explanatory notes which would not be subject to any further explanation than interpretation?

GODOWN: I do not think we can change the laws of evidence of the English system that we both live under and operate under. It will be necessary to approach it in some traditional way which will permit an opportunity for the defence or opposing clients, to test the correctness of whatever your report is. To me this means that you have to take the direction of the deposition or deposition by interrogatory, which are the only means that I know of at the present time. The difference being that one of them is a deposition at which opposing attorneys or your attorney is not present, there are certain written questions submitted which you answer those in writing under oath. This method would permit you to illustrate to a considerable extent, and would shorten your testimony because you stick strictly to issues. It has some good points but also some difficulties. There is a tendency for each side to run hastily through a transcript of some 50 pages and sum it up in about 15 words.

SOMERFORD: Mr. Duxbury raises a very important question and that is as to how extensive our reports should be. Our idea has been to confine it to the findings insofar as possible without a detailed explanation of how that was arrived at. We reserve that for the working sheet that is placed with the file. The reason for this is that we made a survey and we found that our investigators were not concerned with how results were arrived at.

### Discussion open to the floor

SCHMIDT: In regard to submitting reports from the document examiner to the courts, the only time it might be feasible to do this would be during preliminary enquiries or grand juries where what is going on is not actually a trial but a meeting, to find out if there is actually a prima facie case.

HILTON: On this matter of reports and the use of them in court. One possibility has been lost track of and this is that any report of an expert can be stipulated. Occasionally this is resorted to by clever defence attorneys stating they are perfectly willing to stipulate the report of the expert to keep the man out of the court in hopes of lessening the effect of the testimony. I would rather advocate that the prosecuting attorney should be advised against accepting these stipulations and to call the expert unless the other side will admit to the full facts to be presented by the expert, rather than merely stipulating the report.

DUKE: I think the appearance of the expert in the court is desirable in that it gives the judge and the jury an opportunity to observe the demeanour of the witness and where we have opposing testimony this could have a great affect on the weight or significance which is attached to the evidence.

COLE: I think we should take note of the fact that writing good reports and presenting good illustrations frequently has the effect of avoiding a need for a trial.

BOONE: Then would you put in your reports some considerable detail Mr. Cole in certain instances in an effort to avoid a trial and to assist the investigating officer in the field?

COLE: As a general practice we do not put a great deal of detail in reports simply because we do not have time for it, but I think that one of the best exercises in continuing your training in the examination of questioned documents is the writing of detailed reports. As a matter of practice in my office I frequently designate a case to be given full treatment, even though I know it may not be needed, but if I have information that the writing of a complete report with illustrations may avoid the need for a trial then I would do it.



## Expert Witnesses in Court

W. R. JACKETT, Q.C.

Deputy Minister

Department of Justice

Ottawa

There is an element of misrepresentation in my being billed to make an after-dinner speech on "Expert Witnesses in Court". With an audience consisting of policemen and others skilled in the detection of wrongdoing, I am not likely to remain undetected and I might as well confess freely

- (a) that I have never made an after-dinner speech and I have no special qualifications which would justify me in putting myself forward with an international audience of this kind for a first attempt;
- (b) that I have had no personal experience of any consequence with expert witnesses and none at all with "Document Examiners" or handwriting experts;
- (c) that I have never appeared in a Criminal court except once, as a student, in magistrate's court; and
- (d) that, finally, having no experience of my own on which to base my presumption in speaking of something of which you know much more than I, I propose to crib in a wholesale way from an informal talk given in 1946 by Lord MacMillan, one of law Lords who took part in most of the Canadian cases that went to the Privy Council during the last quarter of a century.

Lord MacMillan spoke to the Institution of Civil Engineers and his subject was the presentation of engineering evidence in the courts and before other Tribunals. However, what he said to the engineers was, I think, of equal application to any *expert* witness. I hope that I shall be able to communicate to you some of the wisdom contained in the remarks that he made in 1946. So that there will be no misunderstanding, I wish it to be understood that anything I may say hereafter may be cribbed more or less entirely from Lord MacMillan but that he is in no way responsible for what I may say.

The expert in the witness box is a very responsible and a very interesting figure.

The expert, as a witness, is, of course, subject to all the ordinary rules about giving evidence. He should be *truthful, fair, courteous* and so on. But the expert, as a witness, has also special rules and considerations applicable to him.

Before coming to the special rules and consideration, I should like to make some preliminary remarks about evidence generally and the ordinary witness.

*What is evidence and what is its purpose?* A court's job is to determine matters that are in controversy and evidence is the information furnished to a court for the purpose of enabling it to arrive at a decision on the particular matter before it. That is very simple but it goes to the root of the matter.

Any particular controversy may raise questions of fact or law. The role of the witness and of evidence has to do with questions of fact only.

Questions of fact (and here I should say I am departing somewhat from Lord MacMillan) are of two kinds, viz:

(a) what are the basic facts?

(b) what inferences may be drawn from the basic facts?

By basic facts I mean things that can be seen, felt or heard or otherwise have physical existence and inferences are the conclusions that can be drawn *as a matter of fact* when the physical realities are known. For example: A man points a loaded pistol at another man's heart and draws the trigger. (basic facts) From that a court would conclude ordinarily an intent to kill (inference).

So, in order to determine a controversy of a factual nature, a court needs information as to the facts and that information must be obtained by evidence. "The giving of evidence is... the process of informing a tribunal of matters that are material for the decision of the question in controversy, and the province of the witness, whether he is a skilled witness or the ordinary man in the street who has been a witness of a tramway accident, is to supply that information."

The ascertainment of facts is a most difficult task. Human testimony, in view of the fallibility of recollection and the influence of motives, is notoriously unreliable. Pilate's despairing cry "What is truth?" has found an echo in many a judicial bosom.

No court can hope to arrive at absolute certainty in the scientific sense on any question. Lord MacMillan dealt with this problem in a decision in the House of Lords in these words:

"The basis of belief may range from mere conjecture through all degrees of probability to absolute demonstration. The three grades are possibility, probability, and certainty. In seeking to arrive at a conclusion in fact in ordinary human affairs the law rejects mere possibility as an insufficient basis of proof; on the other hand, it does not exact absolute or mathematical proof. It is content to proceed upon probability if it is sufficient, and the test of sufficient probability is that the direct evidence, with all legitimate inferences, is such as ought to satisfy the mind of a person of reasonable intelligence."

As you are all aware the "probability" that is required differs somewhat according to the nature of the issue. In criminal cases, generally speaking, guilt must be established beyond a reasonable doubt. Other issues in civil cases or in criminal cases must merely be shown on a balance of probabilities.

And so, it should be borne in mind, a witness cannot, and is not expected to, demonstrate absolutely what he is in court to speak to. But he can show that the probability of the view that he is advancing, or of the facts that he warrants, is so high that the reasonable man would be convinced by it.

Having dealt generally with the role of witnesses and the function of evidence, I come now to the question of how an expert by his evidence may best contribute to the attainment of sufficient probability to justify a decision in a matter within his province.

At once a broad distinction presents itself.

An expert witness, like any other, may have to speak to basic facts. On the one hand, he may have happened to witness an occurrence of a character that is of special interest in his field of study. In that case, his account afterwards of what he has seen is the account of an observer speaking to facts from recollection and the only difference between him and an ordinary witness is that he is a trained observer and knows what to look for. I take it that this is unlikely in the case of a hand writing expert and

I will not discuss it further. On the other hand, an expert may be commissioned to make a special study of facts that may be relevant to a controversy and to report on them. So far as he is a witness to basic facts in such a case, he is again in the category of the ordinary witness; but the material is static and the expert has the special advantage of knowing what to look for and of being able to concentrate on the matters which are of determining importance.

When one of you is asked to compare a questioned document with a number of handwriting samples (for which I know you have some technical expression) you observe and record certain characteristics in the various documents and these characteristics are basic facts about which you can give evidence which is of the same character, in principle as evidence given by ordinary witnesses even though you are the only persons who can see those facts without assistance.

It is worth remembering therefore that when you report or give evidence on such basic facts you are in the same position as ordinary witnesses and that you must always, in striving for accuracy, remember that you are human beings subject to the frailties of human nature.

In that connection, I think it is worth quoting verbatim from Lord MacMillan's talk.

"A distinguished Professor of Psychology in one of the American universities published in 1923, a book entitled PSYCHOLOGY AND THE DAY'S WORK. He was anxious to ascertain what really were the limits of human fallibility in the matter of evidence and he devised an interesting laboratory experiment.

He had an intelligent class of young men and women of the usual age. The class consisted of some twenty-nine students. He arranged one day, without the knowledge of the class, that an incident should happen in his classroom. He planned that three members of the class and another student—two men and two women, all well known to the class—should wait outside in the corridor; that in the middle of his lecture, quite unexpectedly, they should burst into the room; that one of them should drop a brick—I do not mean a metaphorical brick—and that each of the others should do something else; each had allotted to him one definite thing to do. It was an incident of the simplest possible character, without any of the complications of an ordinary accident in the street, where people's powers of observation are limited and the situation is complicated. He staged the simplest possible series of operations.

The door was burst open and these four people came in. The class was very much upset but the professor at once calmed them, saying, 'This is a pure experiment. In the last thirty seconds'—the whole incident lasted thirty seconds—'something has happened in your presence in this room. I want you to take your note-books and write down what has happened in this room in these last thirty seconds.'

Everything was favourable to the ascertainment and recording of truth. Nobody had a motive to find anybody guilty of anything. The transaction to be recorded was free from all complications, and all had been within the direct vision of the witnesses. Each of them wrote down in his note-book what he had seen, and the papers were collected and collated by the professor.

The most extraordinary results were found. There was hardly one of those observers, who had no motive to distort the truth and every opportunity to observe the facts, who did not make a mistake. As a matter of fact, there was not one accurate record of what had happened. Only three knew that four people had come into the room. One said that

a pistol had been fired. No pistol had been fired, but one of the intruders had flourished a banana and detonated a percussion cap. A woman student said that one of the women who came in was wearing a red hat. She was not, but she had on other occasions worn a red hat. That was a case of what psychologists call transferred memory, and so on. The whole thing was typical of the kind of errors that arise. This experiment has been to me a very grave warning of the fallibility of human testimony on a matter of fact."

In giving evidence on fact, therefore, it is exceedingly important that one should be most critical of oneself. When giving evidence upon a question of basic fact, it is of the utmost importance that you be most scrupulously accurate and not say anything about which you are not clear. Verify your facts so far as the means are available to you for verification and see that you have got everything as accurate as you possibly can. *Where you feel uncertainty, candidly confess it.*

The other role of an expert witness is as a witness of *opinion*. This must clearly be distinguished from the two ways, to which I have referred, in which he may be giving evidence as to basic facts. In this role, the witness is, by expressing his opinion, assisting the court in deciding what inferences to draw from the basic facts.

As you know, an ordinary witness is, in general, allowed to speak only to facts within his knowledge. Hearsay and opinion are not permitted to him. Only one exception is permitted and that exception is in the case of what is known as expert testimony.

There are two text book references which may help understand the legal position of experts.

#### BEST'S TREATISE ON EVIDENCE:

"On questions of science, skill, trade and the like, persons conversant with the subject-matter . . . are permitted to give their opinions in evidence; i.e. to state conclusions whether drawn from facts which have fallen under their own observation or from such as are proved at the trial by other evidence. Thus, medical practitioners are allowed to give their opinions as to the probable cause of disease or death or the probable result of a wound or injury; artists to give their opinions as to the genuineness of a picture; shipbuilders to give their opinions as to the seaworthiness of a ship; and the like."

#### SMITH'S "LEADING CASES"

"The opinion of witnesses possessing peculiar skill is admissible whenever the subject-matter of inquiry is such that inexperienced persons are unlikely to prove capable of forming a correct judgment upon it without such assistance; in other words, when it so far partakes of the nature of a science or art as to require a course of previous habit or study in order to the attainment of a knowledge of it."

The point is that the ordinary tribunal has not the knowledge necessary to draw the proper inferences on technical matters from basic facts without skilled guidance.

I am now going to presume, subject to the reservations I made at the beginning, to offer certain advice to those of you who may find yourself in the witness box giving opinion evidence as experts. In doing so, I am assuming that you will find yourself in a highly contentious case with conflicting expert testimony. In those circumstances what rules should you keep in mind?



## **FIRST: Do not be an advocate**

There is, I believe, no error into which the expert witness is more prone to fall than that of becoming an advocate and mistaking his part. The two functions are totally different. The advocate in the ordinary sense of the term—that is to say, the barrister who is conducting the case—is there to endeavour to persuade the court to arrive at a decision in favour of his client, whether he, the advocate, believes in his client's case or not. His personal opinion is of no consequence. His duty to his client is to put the best face on the case entrusted to him and to do all that he can for his client within the limits of reason and fairness.

The expert witness is not in that position at all. The greatest experts are never partisans. They are there as witnesses of truth. When the advocate speaks, nobody expects him to give his own belief; in fact, any judge would pull up a counsel at once who said, "I believe the prisoner to be innocent," and would say "It is no part of your business to say that: it is for the jury to say." On the other hand, the expert is there to tell the truth as he conceives it to be. If he entertains with certainty a view of any scientific or practical matter within his province, let him advocate it as strongly as he likes; *but it must be his own view, not the view that his client would like him to put forward*. This is vitally important. The expert's job is to help the court to reach a just decision in the case. His business is to tell the court as well as he can what he believes to be the true view of the facts before the court. If a fair question is put to him he should answer it fairly regardless of which side the answer will help. He has no right to bamboozle, perplex or mislead the court. If he gives an opinion it must be an honest one and not one propounded for the purpose of winning a decision for a person who is going to pay his fee. This principle goes right to the root of the position of the expert witness and any failure to observe that standard is destructive of the credit which expert witnesses must have in the courts if they are to serve any useful function.

The expert witness, therefore, is in quite a special position. He is an assistant in the ascertainment of truth; he is the purveyor of information on which decisions are to be arrived at; and to the truth and accuracy of that information his professional credit and reputation are pledged.

## **SECOND: Study how you are going to present your opinions**

It is most important that you should study in advance how best to lay your views before the court. The most skilled person who knows everything about his job may present his facts so untidily, so clumsily, that they never get home, whilst a rather glib and less informed person, by a few artifices, may succeed in getting his opinion accepted even though it is quite erroneous, merely because he has some skill in the arrangement and presentation of his facts and testimony. It is a very important part of your homework therefore to plan the presentation of your evidence.

Every problem of presentation is a new problem. I know this because, as an advocate, I have essentially the same problem. However there are some guides that are helpful. Never forget that your opinion, no matter how sound it may be, will serve no purpose unless your presentation catches the mind of the court and carries it along with you to your conclusion. You must not forget either that the case may go to appeal and that your presentation must be persuasive when in cold print as well as when delivered orally. One of the factors in determining your plan of presentation will also be whether the case is being heard by a judge alone or by a judge with a jury. Presentation must vary with the audience.

Having in mind therefore your tribunal, and always keeping in mind that you must get through to your audience, begin with something that it can understand. Begin with something that it knows; lay out the broad and main features of the matter as your point of departure. Do not plunge at once into technicalities or niceties but add them to your narrative as and when the court has grasped the guiding principles and main outlines sufficiently to understand what you are talking about.

If you can make your introduction to your presentation not only accurate and reasonably brief but also attractive and interesting, as any technical subject can be made to the lay mind, you will have gone a long way towards arriving at the desired result of making the court understand what your opinion is and at the same time appreciate its intrinsic soundness. People are very apt to be induced to arrive at a decision if they be led to it by an easy track and by guides who are competent. There is a certain satisfaction to a layman, whether he be a judge or a policeman, in understanding a problem in somebody else's sphere of activity. There is an intellectual satisfaction in apprehending something that is not your business but which is presented to you as a problem for your solution. Keep these fundamentals of psychology in mind in preparing your presentation.

### ***THIRD: Never be dogmatic***

Nothing offends a tribunal more than a person who is portentous in the expression of his views. We know how fallible even the highest opinion may be. It has been said that "Even the youngest of us may make mistakes". Avoid above all the tone that conveys that you are inevitably right.

Lord Macmillan told of a witness of long experience who was able to strike the right note. I should like to give a small part of his remarks about that witness verbatim.

"I was examining him about the habits of salmon, and I put to him a passage from one of the most authoritative textbooks on salmon fishing. I said, 'Do you know So-and-So?' mentioning the author of the book, and he replied, 'Yes, he is a great authority.' I said, 'Yes, but that authority expresses himself as follows;' and I read a passage adding—'That does not seem to be at all like the evidence which you have given to this Committee.' 'Well,' he said 'I am not surprised that you quoted that to me, Mr. Macmillan. That is a very great authority, and he may be right. All that I can say to the Committee is that it does not consort with my experience. I have had about twenty years experience of this sort of thing, making my own experiments and my own hatchery, and so on, and, while I pay every deference to the opinions of so distinguished a person, I am here to give only my own evidence, and my experience has led me to a different conclusion.' There could be no further cross-examination on this point, and the Committee, of course, believed every word said by a man who was so candid and disarming."

A rather more humorous experience of which Lord Macmillan tells, which is also most instructive, he described as follows:

"The practice of bringing up what witnesses have said and done in the past is apt to be awkward for those with a long engineering record who have appeared before many tribunals. To be entirely and always consistent is not easy. In my very callow days I remember cross-examining Sir William Copeland, in those days a well-known water engineer, and a venerable and very impressive figure. I had been supplied with the proceedings in some inquiry at which he had been a

witness, and I thought that I was going to get a really good point home. 'Sir Willam,' I said, 'Were you engaged in the inquiry in such-and-such a case?' He said that he was. I went on, 'Do you remember saying this?' and I read him out a statement which was directly contrary to what he had said that day in court. He looked at me in the blandest way and asked what was the date. When I gave it, he remarked: 'Ah, yes, twenty years ago. I can only hope Mr. Macmillan, that in your profession you will have learnt as much in twenty years as I have in mine.' The retort was courteous but unanswerable."

I am sure that an expert witness will find, just as an advocate does, that, if you are not too cocksure and if you candidly disclose your difficulties, you will find that the court will probably aid you in overcoming them, if they can be overcome. Certainly, for an advocate, it is most dangerous to gloss over a difficulty and let the other side bring it up with devastating effect later on. State your difficulties at the earliest opportunity as a difficulty which you must face and put your view forward. This puts the difficulty in the place where you think it belongs and deprives your opponent of any advantage he might get from making the court think you had overlooked the difficulty when forming your conclusion.

If an expert states a difficulty fairly and squarely and then gives the best solution that he can, he will find the court disposed to look favourably on his evidence because of its honesty and candour. Moreover, it is a satisfaction to the witness himself to feel that he has discharged his duty in accordance with the highest standards.

To sum up all three points: Do not be dogmatic, be as simple as possible, as brief as possible, as straight as possible and as interesting as possible and never be portentous.

One final bit of advice, I will give in Lord Macmillan's words:

"Let me add another thing and a very practical one: Do be tidy about details. I am sure you have all seen something like this happen. A witness of the highest competence is called. He has a mass of documents, but his clerk has failed to arrange them accessibly and in the proper order. He has his own notes, but there is no adequate tally with the documents. The witness mentions some previous report which he has made, and the Chairman asks to see it. There is a frenzied search for it and finally a document is handed up to the Chairman, who says, "I am afraid that this is not the right report." The witness says "We will try to get you the right one." and it takes five minutes before it is at last identified and produced. The whole continuity of the evidence has been disturbed and attention distracted. I have seen that sort of thing happen over and over again.

The right thing to do is to note on the margin of your proof the reference to each document which you are going to use, numbered or lettered, and to have your file of documents in exact correspondence with your notes, so that each document is handed in as you reach the point at which it becomes relevant."

"This merely mechanical facility has a PSYCHOLOGICAL effect. It is like finding your place in the Bible; there is a feeling of satisfaction when the parson gives out a text in Haggai and you get it at the first shot'. If you so arrange your material that those whom you are addressing can find what they want at once their attention is not distracted from the tenor or exposition. What is presented in an orderly way and can be easily assimilated somehow or other remains

in the mind and impresses the mind. There are no awkward interruptions while a paper is sought for that is not there and the documents are kept together in their proper sequence. If the papers are all loose and untidy some of them inevitably go astray in the course of the proceedings, causing further delay and confusion. The mechanics of the presentation of evidence, the mere arrangement of things in an orderly fashion so that there is an appearance of completeness, showing study and care in preparation, has a singular effect on the recipient mind, and indeed goes a considerable way towards inducing assent.

I have been talking about the incidentals of evidence, as well as the larger questions, but the incidentals are not unimportant. One is often very much more influenced by the comparatively small things in life than by the comparatively big things, and the way in which things are done is in itself influential. The conduct of the engineering witness in the presentation of his opinions or of the facts to which he is there to speak, the way in which it is done, the mental attitude exhibited, his courtesy, his reasonableness—all those features, if cultivated and exhibited, have their effect. These are things which are well worth studying.

All of you have seen examples of great minds failing to succeed just because of their inability to attend to comparatively trivial things. Details are not trivial to an artist and the engineer witness is an artist; he is engaged in the art of communication from one mind to another, which is one of the most subtle arts in the world, and how he does it is the test of his skill. The great decisions in life are almost all taken in consequence of the communication of information by one person to another, and how those communications are made is therefore a matter of supreme importance."



The material recorded here is a condensation of many thousands of words exchanged during the course of this seminar. Every effort has been made to retain new ideas, technical information and the worthy opinions of the speakers in as unbiased and undistorted a fashion as possible, without sacrificing accuracy to the interests of brevity or economy. For obvious reasons many comments of an "off-the-record" nature must be omitted. As a result many remarks have been rephased.

Certain views expressed were endorsed by other persons present, but in general these endorsements have not been included.

If, in the production of this record of the proceedings of the seminar, words have been put in mouths which cannot now be recalled or were not intended, then this editor must assume full responsibility for them. The communication of ideas being as complex as it is, it can hardly be expected that no errors have been committed. It can only be hoped that they are not important, and are pardonable.

R. A. HUBER, Sgt.  
*Editor and Program Director.*









